EDITORIAL

AFTER having seen something of radio and TV in operation overseas, let me say again that Australia's system of blending National and commercial stations is by far the best in the world.

The reason is, I think, two-fold.

Firstly, it is an enormous advantage to have a body whose main purpose is to see that all those things which should be broadcast do in fact go on the air.

Commercial radio must be profit earning if it is to continue, and in the nature of things it must concentrate on programs which will attract sponsors.

It is true that the proportion of the public interested in the more highbrow type of entertainment, in which we can include things such as classical concerts, plays, and discussions, is comparatively small.

But all these things must be included in programs as a whole, and they are not the most sponsorable material.

While some of this material does feature on commercial stations, the picture is most complete when National and commercial services can work together in adequately covering the field.

Secondly, despite this complementary function, there should still be enough competition between them to keep everybody on their toes.

I am sure the introduction of commercial stations into Britain will raise the standard of programs and broaden their outlook when the initial period of settling down is over. Despite the admirable record of the BBC, its efforts will be even more valuable through the impact of its contemporaries.

America I feel would benefit from the introduction of a National network. The big networks already spend a good deal of time on the better type of program, but the net result isn't nearly as good as it might be. This fact isn't as apparent to the American public as to an outsider, for every audience grows conditioned to what it has, making it less interested in what it might get under a different system.

But Americans who have always had their radio and TV for nothing, are most unlikely to accept any plan which calls for a licence fee. For the same reason I doubt whether they will ever be interested in any scheme such as Phonevision, which calls for a payment for special programs. Free radio and TV is part of their way of life.

I can only be optimistic about the eventual standard of entertainment Australia can command in TV as well as radio, if both National and commercial interests see clearly their own individual functions, and carry them out with foresight and restraint.

John Moyle

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RADIO TELEVISION & HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

A precise and continuous check is needed on all operations involved in the production of color-television picture tubes. An operator at the RCA Tube Division Plant in Lancaster, Penn. checks the position of the dots on the faceplate of a new 21-inch tube. These dots have previously been fixed by a light shining through a shadow mask.

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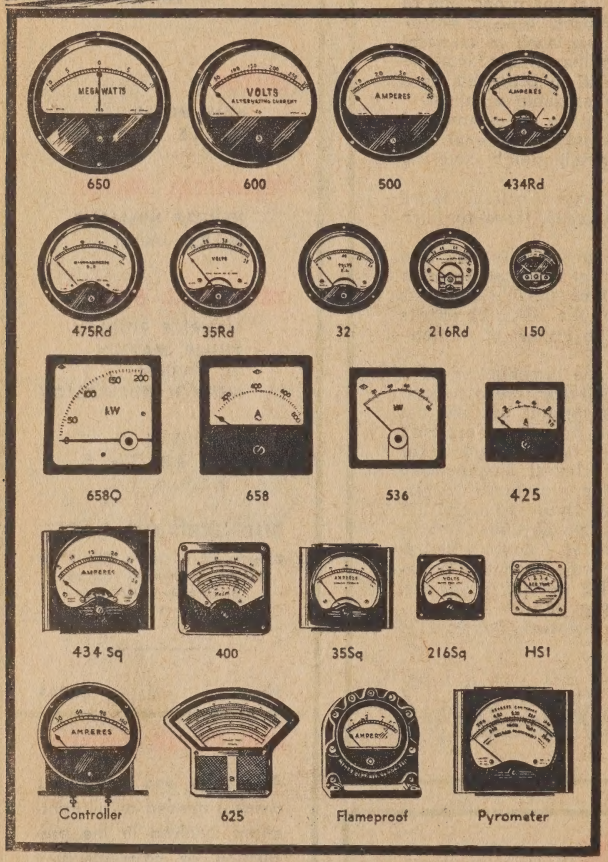

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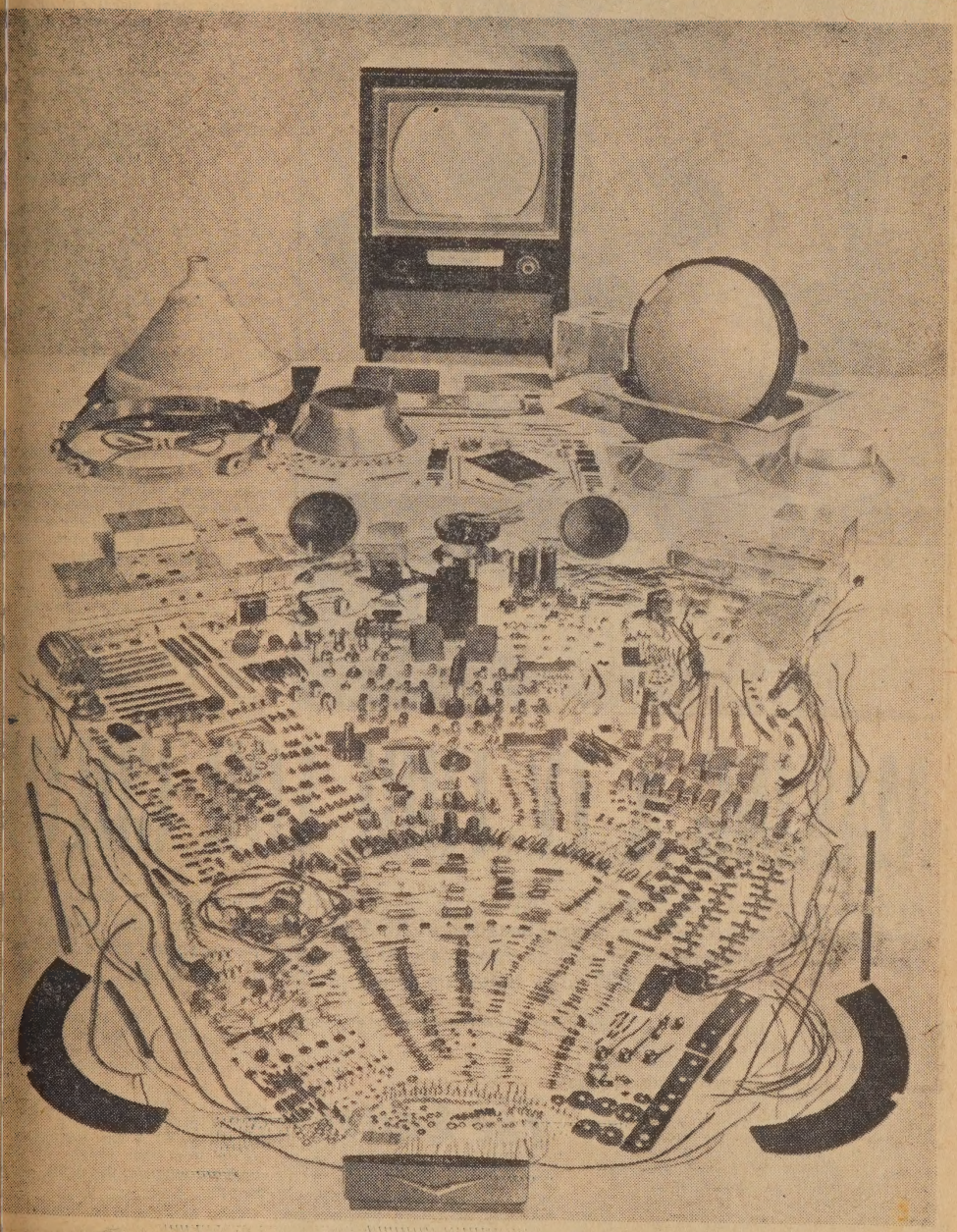
HOW MANY PARTS MAKE A SET?



many parts has a color TV set? This RCA-Victor receiver has 2076 of them, and not all made in the RCA factories. As many as omponent manufacturers are concerned in the provision of parts, many of them quite small specialist businesses located in many nt sections of the country. These components are made up into a number of sub-assemblies for attachment to the main chassis which is put together at the factory.

A color TV tube has 3 electron g instead of one as in a standard b and white tube. Here a three assembly is inspected at the R plant at Lancaster, USA.

MAKING A TV TUBE FOR COLOU

At the present time, the USA is the only country in the world in which regular color TV pr grams may be seen. This is so largely because of RCA's tri-color picture tube, now in ma production. During my recent visit to America I was a guest of the company at its Lancast plant, where 20,000 color tubes are being produced each week.

by The Editor

THAT it has been possible to advance the manufacture of this tube to such a point represents an engineering triumph of the first magnitude. Only a year or two ago it was considered a near impossibility.

But today, after perhaps six months in action, the production line is able to reckon on about 75 pc perfect tubes, and of the rejects practically all are more or less reclaimable. In any case, major faults are detected before they reach the end of the line, so that the tubes can often be sent back for reprocessing.

For some years prior to 1950, RCA and CBS had been indulging in keen rivalry to produce a color system good enough for commercial use. Each was intent on impressing the FCC, the American authority controlling communications, that its method should be adopted as a standard.

It was in 1950 that public hearings were held to decide the matter. As a result, the CBS system was thought to provide the most satisfactory pictures, and was adopted pro tem.

But it was a mechanical system, a rotating color wheel not esser different from the early mechi methods for black and white TV, was convinced that its electronic tem must prevail. Moreover, R tube when perfected would all compatible TV system, that is, a program could also be received o ting black-and-white set, and versa. The CBS system was not patible, which fact placed it at a s disadvantage.

Then followed a long series of suits in which the industry in ge and RCA in particular, attempte upset what was considered an ou eous decision by the FCC. The troversy was joined by other elec firms which had played a big pa developing color systems, and it is haps fortunate that the Korean and its demands upon the industr an end to the CBS color broad which therefore died almost at

NTSC PROPOSAL

Out of a rumpus in which powerful organisations figured, which raged with great bitterness a rich prize at stake, the National vision System Committee, a bod up by the industry to work out a tem of color standards, finally duced an answer which was acc by the FCC, an answer in whic CBS also concurred. Thus ende ever the short reign of the mech system, for the new standards pr posed an electronic picture tube.

From all this, in which the ult credit seems lost in a wide set of and counter-claims, RCA finally up with its present tri-color tube a tremendous effort of researc development which literally exh its resources and its personnel.

But the result is that today, w least three other promising meth making picture tubes are still laboratory, RCA has apparently far in front that nearly all the receivers sold in the USA hav its tube.

This very rapid summary of TV history is given purely as a ground to a description of how ingenious device is made, for th is too long and complicated to detail. RCA is now pressing effort to establish its lead so that competition will fade by de

t is too early to say whether
l be so in fact. Behind the
there is always the possibility
neone will develop a new, ultra-
tube which will be easier and
to make and yet still work in
NSTC standards.
d this happen, it is highly likely
whole position once more will
the melting pot.
asis of the tube's operation is a
n cathode ray assembly in which
n is actuated by a signal fed to
for red, one for blue, and one
n.
electron beams from each gun
led to the display screen of the
rough a perforated metal mask
ery close to its inside face.
se in a given time each of
e electron beams passes through
ne perforation at a different
here are three small points of
c illumination thrown on the
or each hole in the mask.

R DOTS

e point illuminated by the "red"
re is placed a small spot of "red"
r, and similar spots are provided
"blue" and the "green" gun.
e screen, instead of being coated
plain phosphor film as for a
nd white tube, is covered with
"colored" phosphors in groups

a picture is being received, each
dots glows with its appropriate
cording to the signal fed to its
e gun. As the whole face of
is scanned in the normal man-
combined colors of these groups
nto a complete picture, built up
ands of colored dots, which give
ed image and color values.
implified problem of manufac-
erefore, is to build a three-
electron gun which will fire its
beams accurately through the
the mask, to build a mask with
les placed with perfect accuracy
surface, and finally to coat the
f the picture tube with groups
hor dots accurately aligned with
s in the mask.

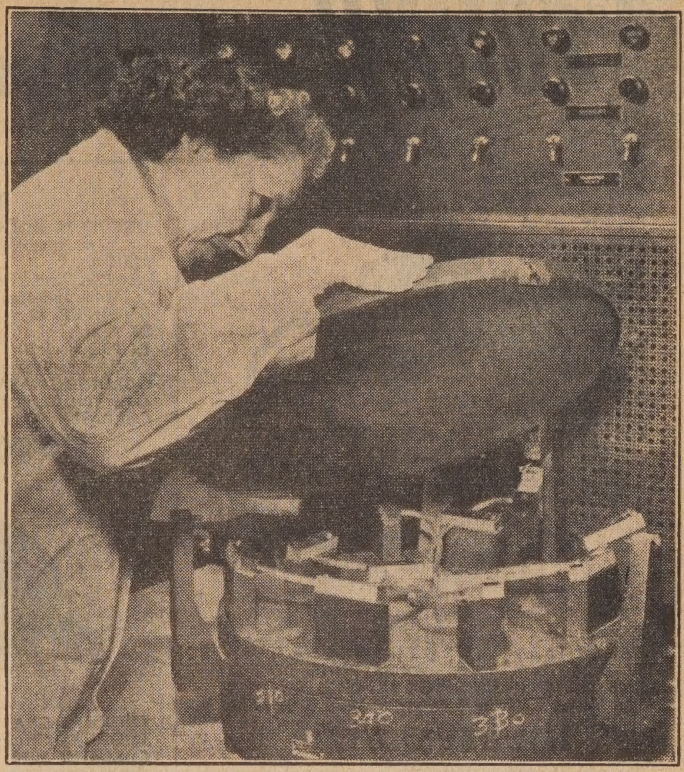
STIC ACCURACY

egree of accuracy with which all
t be put together can be gauged
c fact that there are 350,000
the mask of a 21in tube, and
0 phosphor dots on the face of
, three for each hole in the

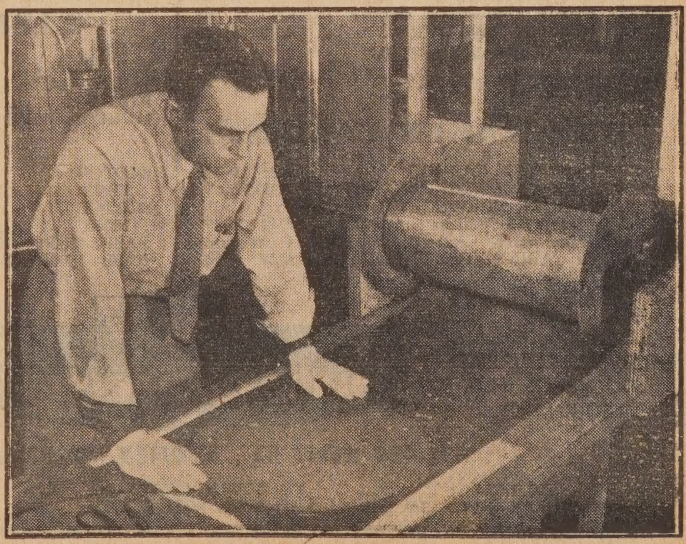
lectron beams are deflected by
agnetic yokes placed around the
the tube in the normal manner.
of the interest in the manufac-
the tube lies in the preparation
mask, its registration with the
the screen, and the coating of
en itself.
irst step on the production line
ssembly of the tri-section elec-
n. Each of the three sections is
lly the same, and the whole

low masks in color tubes are made
al metal, and each one is perfor-
h 350,000 holes. It would be im-
ble to punch so many fine holes
distortion of the metal. The pattern
holes is therefore printed photo-
lly on the metal, and the holes
es are etched through with acid
solution.

TESTING TV MASK FOR ACCURACY



Both the glass face of the TV tube and the perforated mask must conform within fine limits to a pre-determined contour. When the mask is settled in place on this machine, it should fit closely upon a number of contact points each of which is connected to a pneumatic system. If the fit is a good one, the variation in air pressure at each point will be the same. If it is not, it indicates a distortion of the mask from its ideal contour.



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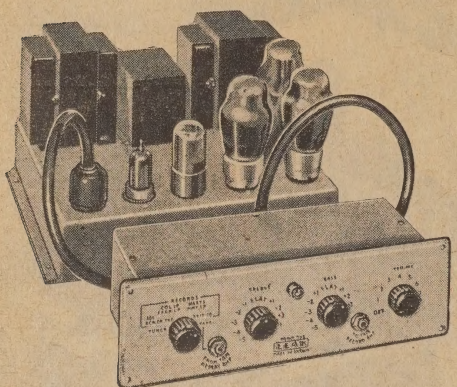

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ly, step by step, is done by hand
series of girls who mount the
components with the aid of
ely aligned jigs.
cathode assemblies are an im-
part of each gun and are put
r elsewhere before reaching the
Because each of the three guns
e as electrically similar as pos-
hecks are made during assembly
nce up the emission from each
so that, when the tube is mount-
the finished receiver, any differ-
between the guns will be within
justment range of the receiver
s. Otherwise it might be impos-
o balance up the color values
are essential for an acceptable

general process of assembly is
to that for single gun tubes. The
l supports for the various gun
are held in position by being
into molten glass rods at the
riate time, and the three guns are
d in collars which provide them
rrect alignment and which ultim-
t closely inside the glass neck of
e.

ALIGNMENT

ingenious method of fine ali-
f the three electron beams is pro-
by fitting small metal clips to
c positions on each of the guns.
n the tube is completely assem-
ese clips can be moved slightly
ns of magnets which are applied
outside of the tube neck.
ections to the gun elements are
y a series of those incredibly fine
lding operations at which assem-
e operators become so adept.
ying glasses are used at this stage
ect the guns as they are assem-

ly the finished guns are sealed
body of the tube, which at this
is no attached display screen. The
tube is made of metal rather
ass for a reason to be explained
id projects several inches through
e of the tube.
ready mentioned, the neck of the
made of glass, but the conical
ction to which the display screen
imately be attached is made of
welded to the glass neck. This
lone merely to provide strength.
simplifies the attachments of the
reen, as will later be apparent.
metal-glass body section is not
ed at the factory, but is de-
in one piece from the glass

AND SCREEN

the gun section of the tube is
ade, another division of the fac-
preparing the shadow mask and
s screen.
atter also comes into the factory
e glass works, and is ready-fitted
metal flange welded or fused to
r edge.
flange has two purposes. Into
surface the metal shadow mask
snugly to provide accurate align-
nd to its edge will later be weld-
netal cone of the tube body when
comes to "put the lid on".
haping of the metal flange must
rate to extremely fine tolerances
ure the fine accuracy of the
nt with the shadow mask.
shadow mask is like a shallow
vered with minute holes. The

DEPOSITING SCREEN PHOSPHOR

The process of depositing the phosphor solution over the inside of the 21-inch tube has been reduced to a simple method by which the correctly prepared solution is poured over the inside surface of the glass and distributed by a rotating-tilting action. When the glass has been completely covered, the excess solution is poured off to one side. The process is entirely automatic.

edge is shaped in a press so that it fits closely into the flange of the screen. Small semi-circular sections are cut from the edge of the mask to give enough flexibility to spring into place, and registration marks are crimped into both the screen flange and the mask rim so that the latter can be slipped in and out of position during future processes.

These crimp points are placed irregularly around the edge to ensure that the mask can only be re-inserted at a fixed rotational position.

The holes in the shadow mask are too fine to be punched in the metal sheet—they are therefore etched through with corrosive chemicals.

The correct pattern is first printed on the metal photographically which leaves the tiny dot areas unmarked. When the chemical solution is applied, only these unprotected areas are attacked and eaten away, the process being quite similar to ordinary printing block manufacture in reverse.

When the etching is complete, the metal sheet is cleaned down leaving the shadow mask beautifully pierced with holes.

This is done before the mask material goes into the press which, in one operation, forms its rim, and gives it a concave shape to match that of the display screen.

The fine registration of the phosphor dots on the display screen with the holes etched in the shadow mask is obtained by using the mask itself as a template during manufacture.

Without this most ingenious method, such registration would be virtually impossible.

The first RCA tubes carried the dots on a flat glass plate inserted at the back of the tube face. The idea of using the curved shadow mask as a template to apply the dots directly to the display screen was developed by CBS Hytron and later adopted by RCA.

The correct contour of the glass screen

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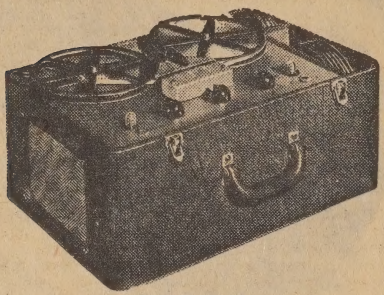

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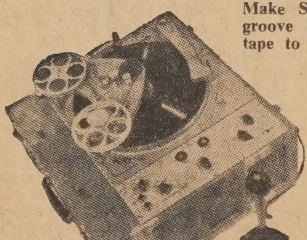

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already been tested by the glass
er who fabricated it, but it is still
essary to check the contour of the
k to make certain that it contains
distortion which would prevent it be-
correctly spaced from the screen
its full area.
s contour is not exactly the same
hat of the screen, because the elec-
geometry of the tube does not en-
that the electron paths are sym-
rical as they sweep across it during
scanning process.
ne of the photographs shows how
mask contour is checked by settling
gainst a number of suction points
ated by an air pump which registers
air pressure at each point.

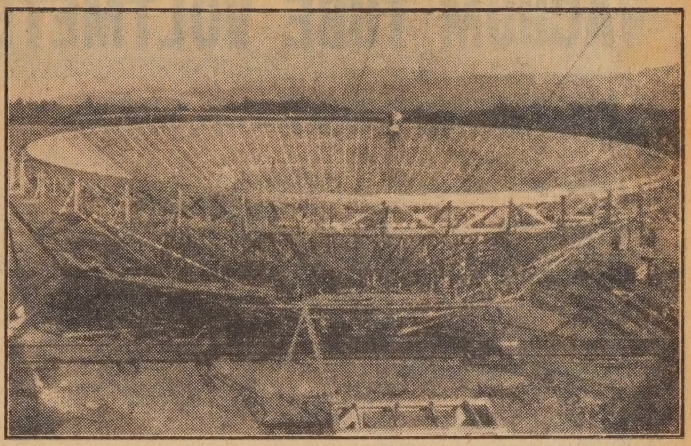
ST PASS TEST

the mask is within tolerances, these
sures will remain within satisfactory
s when it is rotated into any posi-
and placed against them.
ny mask which does not pass the
is discarded.
he first step in the preparation of
display screen is to coat the inner
ace with one of the "color" phos-
s after it has first been thoroughly
ed and dried.
he phosphor is mixed with a photo-
ng solution which will cause it to
re to the glass only after exposure
some minutes to a very strong light.
spread evenly over the glass by
tating-tipping motion of the machine
h carries out all these processes,
phosphors being mixed as required
poured into the screens by hand.
he machine automatically tips out
excess solution from the screen
he latter is turned over for drying.
t this stage, the screen is lifted
the carriage of the machine and its
ow mask slipped into place by an
ator. The same operator now
nts the assembly over the top of a
ce which shines a strong light
ugh the mask and on to the screen
uch a way as to duplicate exactly
manner in which the appropriate
ron gun will ultimately illuminate
ith its electron beam.
his is by no means a simple matter,
required the development of special
s to duplicate with a single light
action of the electron beam during
action of scanning.

TS REMAIN

fter the required exposure time has
sed, the assembly is removed from
"printing" device and the shadow
k taken out of the screen. The latter
back to the original machine which
washes away the phosphor coating,
pt, of course, the spots, which have
fixed to the glass by exposure on
printer. After being again dried
cleaned, the screen comes to the
of its "first time around", and is
y for inspection.
his is done by illuminating the
n with an ultra-violet light and ex-
ning the dot structure through a
nifying glass. A good screen will
a uniform color, according to the
of phosphor which was used, and
dot will be perfectly placed and
ed.
it passes inspection, it goes through
machine a second time, during which
econd set of dots of a different
or" is positioned exactly as was the
But if it is faulty, the screen

TO PROBE SECRETS OF MILKY WAY



The first big radio-mirror telescope in West Germany is now being built on top of the 1450ft Stockert Mountain near Munstereifel. It will belong to the University of Bonn. The telescope will have a parabolic mirror made of light metals weighing 20 tons and a diameter of 83ft. The mirror, fitted to a 50ft high concrete tower, will be able to move in a full circle to follow every movement of the stars. This Bonn telescope is especially designed to examine the expanded dark clouds of hydrogen which fill the sphere between the stars. These observations will bring to light new aspects of the spiral-like arrangements of the star system in The Milky Way, in which our sun has a place.

is cleaned off completely, and its treatment begins again from scratch.

If the second time around is equally successful, the screen is processed a third and last time, using the final color phosphor.

It will now be completely covered with a perfect pattern of phosphor dots, each quite separate from the other, but so placed that the screen is as fully occupied as possible.

It will be seen how important is the exact registration of each screen with its shadow mask, for unless they mate perfectly each time the latter is removed and replaced, the critical positioning of the dots on the screen would be quite impossible.

It is equally obvious that, once the coating of the screen commences, the mask used must be clearly tagged so that it can be located at any time during manufacture until it is finally fixed in position.

ALUMINISING PROCESS

The screen must now be prepared for aluminising, the depositing of a fine metallic screen over the phosphors to increase the picture brightness by partial reflection. But first the dots have to be ground down to an equal height so that the aluminising deposit will be even.

This grinding is done by swilling a quantity of fine powder inside the glass screen, one more carefully calculated and controlled process.

The next two steps — the application of the aluminising coating and the dissolving out of the light-sensitive binder solution which fixed the phosphor to the glass — were carried out in a conditioned room with re-inforced windows. I was not shown these in detail, either because my hosts were not eager to display some unusual methods or because it was not desired to break the control which was obviously placed on personnel and their work.

I gathered, however, that the dissolving agent was highly explosive and needed handling with care. I am not sure, therefore, whether the metal film is sprayed or vaporised to the display screen.

FIXING TOGETHER

The time has now arrived to fasten the screen and shadow mask permanently together, and this is done by spot welding the mask to the metal flange of the screen.

Finally the screen assembly is clamped to the body of the tube which carries the gun, and rotated in a specially designed arc-welding machine which unites the metal edges of the screen flange and the body cone to a depth of about 1 millimetre.

An extremely critical step in the tube's manufacture is the annealing, exhaust and cooling cycles which are carried out in a huge apparatus entirely automatic in its operation.

Each tube is placed in a receptacle which passes slowly through a succession of operative bays to the far end of the machine. Here the tube emerges at the end of its exhaust cycle, and the metal exhaust tube is nipped off short by a pair of heavy shears.

The blades of these shears are so designed as to produce a "cold weld" at the point where the tube is nipped, thus sealing it off and removing the excess length at the same time. This method avoids the more awkward one of using gas flames and a glass exhaust tube, the end of which is more difficult to handle and is more easily open to damage.

After sealing off, the tube resumes its

(Continued on Page 117)

VACUUM TUBE VOLTMETER VTVM200

KLEMT

A fine quality direct reading instrument for use up to 500 Mc/s, supplied complete with HF germanium probe and 30 Kv high voltage probe.

Voltage Measurements:

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Accuracy	+ or — 5% on Sine Wave: + or — 3% on DC.
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Resistance Measurements:

Resistance Ranges	10 ohm . . . 1 K.ohm/10k.ohm/100K.ohm. 1 Megohm 10 Megohm/100 Meohm.
Accuracy	+ or — 10%.
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Consumption	10W.
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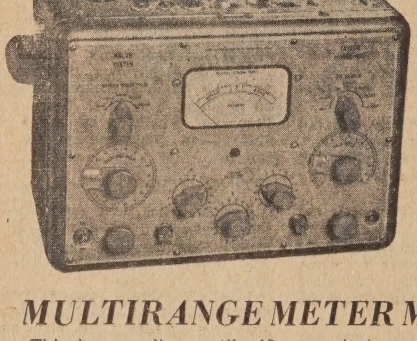
Weight	Approx. 4½lb.

PRICE complete with Diode HF probe, 30KV-HV probe and test leads £73

TAYLOR

MUTUAL CONDUCTANCE



VALVE TESTER Model 45C

Comprehensive Valve Tester which may be used to measure mutual conductance of most types of British, American and Continental receiving valves. The instrument is supplied complete with detailed Instruction Book and Valve Chart giving full testing data for over 4000 different valves. Facilities are provided for testing mutual conductance, cathode, leakage, emission, inter-electrode shorts, heater continuity and gas test.

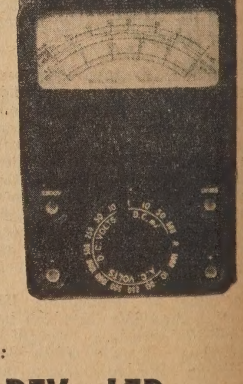
The sensitive moving coil meter is provided with a separate coloured scale indicating "REPLACE" "?" "GOOD" on emission tests. It also has a calibrated scale for cathode leakage and mutual conductance readings.

Twenty valve holder bases are included as standard on the instrument — these can be further extended by the use of adaptors as new valve bases are introduced.

TV Tube Adaptor, suitable for testing most modern TV tnbes is available as an optional extra.

PRICE £56/9/6

MULTIRANGE METER Model 120A



This is a small versatile 19-range instrument of sturdy construction. Sensitivity is 1,000 o.p.v. on both A.C. and D.C. The following ranges are provided:

Volts D.C.	Volts A.C.	Milliamps D.C.	Resistance
0-.25	0-10	0-1	0-2,000 ohms
0-10	0-50	0-10	0-200,000 ohms.
0-50	0-250	0-50	These ranges can
0-250	0-500	0-500	be extended by
0-500	0-1,000		using external
0-1,000	0-2,500		battery.
0-2,500			

Weight: 14 ozs. nett (.4 Kg. nett). Dimensions: 4 7/8 x 3 1/8 x 1 15/16 ins. (10 x 8 x 4.9 cms.)

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EDITOR'S REPORT ON COLOR TV

No one could have been happier than I was to see the coast of Australia loom up out of the haze a few weeks ago when I finally returned home. It was hard to believe that the landing strip upon which the big aircraft touched down was really at Mascot, and not one of the dozens of airfields which have rushed up to meet me between Bangkok and San Francisco.

is probable, too, that the 36-hour flight from USA had something to with it, for despite the indefatigable istrations of hostess and crew, that haul is a bit of a killer.

o make it a little more trying, I apparently getting ready for a len attack of bronchial influenza ch promptly put me on my back day after I arrived.

nd so it is that, somewhat groggily, n making a delayed re-acquaintance all the things I left behind me.

eading through some of the erial which has appeared in recent s, most of it scribbled on air mail r in hotel bedrooms when I should been asleep, I become aware of e odd words and phrases which ainly did not appear in my original

can only assume that the com- d efforts of the staff were unequal he task of deciphering my hand- ing.

his job has worried our composing n for many a year, so if you were led as to the exact meaning of an spot or two in my overseas screeds, an only apologise for the lack of nd sight on the part of those who to type them out for the printer.

he final weeks of my trip were spent Los Angeles and San Francisco. re I took the opportunity of having ok at a few more TV stations, and e film studios chiefly occupied in ing half-hour films for syndicated use ver the USA. Many of these will in course find their way to one or r of the TV stations in Australia.

SMALLER SCALE

he TV stations on the West Coast much more like those we are build- out here, as against the big head- ters set-ups I saw in New York.

rograms, too, are run at a much r degree of tension than in the . After seeing more of America, concludes that New York and ounding district is a place unto it- —it represents a type of living liar to this enormous city, a fas- tion to some and a repulsion to rs.

sewhere in the USA I got the idea TV exists largely to entertain le, rather than as a heaven-sent ium to carry out a high-speed non- advertising program.

want now to say something about important aspect of TV which so I have not mentioned—to wit, r TV.

first saw color in England, where BBC very kindly put on a demon- ion for me at its research labora- s.

The apparatus used was the same as that which provided a showing for the CSIR. Study Group which at that time was passing through England, and investigating proposals in various parts of the world for color transmissions.

The system was a modification of the NTSC method at present used in the USA and adapted to British 405 line transmissions. The BBC is still carrying out experiments to obtain data which later will be made available to the Television Advisory Committee set up by the British PMG. A standard RCA type of tri-color tube was used in the receiver which I saw.

At the moment there are no regular color services in Britain and no decisions of any kind have been made as to when these are likely to take place, or as to their nature if and when they do.

COMPATIBILITY

Britain, as is every other country in the world, is faced with the problem of compatibility, and a strong desire to use a system which will not require an entirely new set of standards and receivers for color.

If a satisfactory picture can be produced which can also be received on the present 5- or 6-million black-and-white sets in Britain, the temptation to go ahead without reference to systems which might be used elsewhere is very strong.

On the other hand, it might be possible to use future color transmissions

by John Moyle

as the vehicle for introducing a new higher definition technique which might gradually take over from the old.

That, however, is Britain's problem, and one which no one is likely to rush into in a hurry. My impression is that quite a few years will pass before color TV is seen in that country on anything but an experimental basis.

Elsewhere in Europe there is little or no interest in color. There is far too much ground to be covered in monochrome, and much greater impetus to be built up in TV generally before the industry is ready to consider it.

The demonstration given to me in London consisted of some colored slides, some groups of everyday objects, and about half-an-hour of live program from a studio at Alexandra Palace.

The color receiver used a 21in tube, and alongside it was a standard 17in monochrome receiver which was receiving the same programme.

FIRST IMPRESSION

When I entered the viewing room, and first saw the test pattern which was displayed on the tube, it took me a second or two to realise that I was actually looking at a color transmission, and not a colored card. The colors were bright, the definition from a viewing distance of six feet or so was good and the picture was rock steady.

Because of the dot structure on the screen, the line effect was not as noticeable as with monochrome, and the screen illumination therefore more even. In a sense, definition was superior, for the change from one picture area to another was generally accompanied by a change in color, and not merely a variation from one shade of grey to another. Thus the eye could more easily register the line of demarcation.

This effect was even more noticeable on a live program, despite the fact that a close examination revealed some spillover from one color to another.

The first "still life" group to be televised included some balls of wool arranged in a circle, at the centre of which was placed a white mortar and pestle containing brilliant green crystals.

HARDLY RECOGNISABLE

On the monochrome screen the different colors of the balls of wool showed up as different values of grey, but it was almost impossible to recognise them for what they were.

The green crystals came out as a black smudge which might have been anything.

But on the color screen the wool balls were quite unmistakable, even to the instant detection of individual threads, while the green crystals were rendered just as vividly.

The point I am making is that the presence of color added immeasurably to the amount of information given on the screen, so much so as to make an almost unintelligible picture perfectly plain.

Later on a color film was run containing a scene which struck me as being particularly effective. It showed

IRC AUSTRALIA

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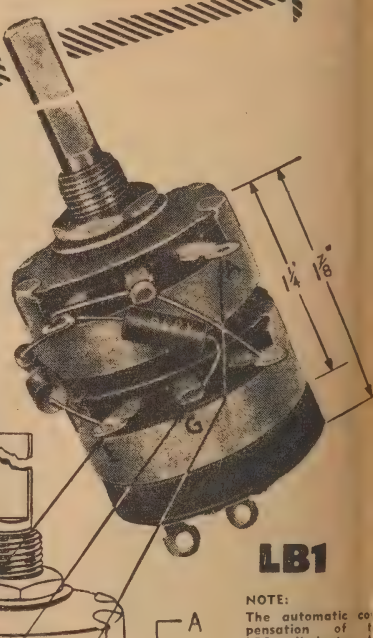
has been designed to replace your existing volume control

and to provide correct high and low frequency compensation as volume is reduced . . . thus maintaining the correct tonal quality right down to whisper level.

(Patent Applied for No. N11262)



LB1

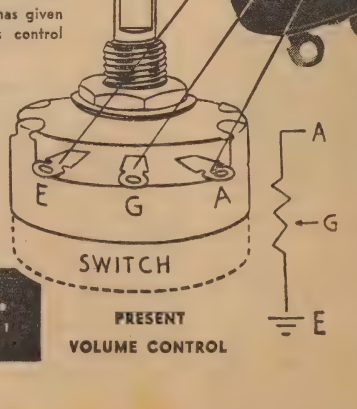
For many years there has been a need for a volume control in audio systems which would automatically keep the proper balance of all frequencies within the audio range at **any** listening level. I.R.C. has developed such a control, known as the LB1, to meet this need.

With the loudness control it is possible to reduce the output volume of any good or average audio system to a whisper and still be able to hear every tone with perfect balance, as the LB1 **provides gradually increasing high and low frequency boost** as the volume is reduced to offset the deficiencies of the human ear, **which is insensitive to high and low frequencies at low volume.** This accounts for the reason why many audio systems are operated at such high levels to give the best listening effect and in this process they become annoying to other members of the household and neighbours.

Many attempts have been made to obtain correct tonal balance by means of tapped volume controls, various types of bass and treble boost circuits and stepped type loudness controls, but none has given the performance of a truly continuously variable loudness control such as the new I.R.C. LB1.

The I.R.C. new loudness control consists of two separate volume controls operated from a single shaft of standard size and used with a combination of capacitors and resistors which are already wired. The unit will replace any volume control by transposing 3 simple connections, as indicated by the illustration at right. Can be fitted without experience.

Contact your usual supplier for illustrated literature.



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REPORT ON COLOR TV (Continued)

copard stalking through a mass of
gle foliage.

Vith the monochrome picture it was
e difficult to detect the animal at
despite its movement—the single
r operated as an effective camou-
e.

ut on the color screen, not only
the leopard clearly visible, but
whole scene came to life.

T FAIR COMPARISON

is only fair to say that a film ex-
d for color does not normally make
most of light contrasts which are
necessary to obtain good moulding
black-and-white—on the contrary
ssive contrasts are generally avoid-

ut even allowing for this fact, the
onstration emphasised so strongly
added interest of the color that I
d the monochrome picture along-
it dull by comparison.

**hat demonstration, despite the pro-
tions of the BBC engineers that
as not their best effort, convinced
that the "ultimate" TV picture must
n color.**

rossing now to the USA, I found it
paratively easy to see many color
idcasts. The NBC which is affiliated
RCA, has an extensive color in-
ation at New York's Radio City,
quite a few hotels and public places
color receivers.

ly first reaction to the American pic-
s was that the colors were rather
sh and overdone. Here was glorious
nicolor with a vengeance! The
d picture interest was there, but it
me obvious fairly quickly that the
duction of color had added enorm-
y to the technical difficulties of
ining first-class pictures.

am not convinced, however, that this
ig color is necessarily inherent in the
m itself. The use of more lines
the British system would, of course,
to load the screen with more avail-
color. But the Americans like
effects "hot and strong", and final
r balance is capable of wide varia-
at the hands of the transmitting
ator plus, of course, the service-man
initially adjusted the controls on
set.

HTING PROBLEMS

ne effects of studio lighting on color,
are quite profound, and it was fas-
ing to watch closely the changes in
values as the operator at the trans-
r strove for the best effect.

may be significant that the best
all color balance was to be ob-
d from the set patterns which
ed the announcer at the beginning
end of a session, for which the light-
and the scene in general would no
t be under the best possible con-

here is no doubt at all that the prob-
of presenting a complete transmis-
in color are immensely greater than
for monochrome. In this the
al experience of the motion picture
1 is valid, to which we must add
electronic difficulties which the film industry does not have to face.

It is also very much more costly, for not only is it much more complicated technically, but the demands on scenery, costumes and lighting are far more exacting.

Color demands the whole works and while I am filled with admiration for what has already been achieved, I think there is plenty of room for improvement before it finally "arrives".

Some of the transmission difficulties which beset TV are more objectionable when observed with color.

Ghosts — duplicate pictures which sometimes show up on the screen displaced by varying degrees from the original image—can cause strange effects on color. These and other picture defects are caused by reflections of the signal from nearby buildings or land masses, and can cause havoc with color distribution.

COLOR FRINGES

Nothing is more disconcerting than to watch a color picture in which the subject matter has a red strip along one side and a blue one along the other, to suggest a possible result.

Receiver adjustment troubles of a type which might be almost unnoticed with monochrome can give the picture a bias toward one color or another, and if the fault is variable, this color bias can be constantly changing.

The latest receivers now coming from production lines may be of better quality, but I saw very few sets which were free from faults involving color values.

The way of the pioneer has never been easy.

RCA seems to be the spearhead behind the spread of color TV in the USA, and my impression is that, together with the NBC, no effort on their part is too great to hurry up both the provision of transmitters and receivers.

It does not seem likely that anyone has yet made any money from color —on the contrary. Every effort is being made to get something going at all costs, with the ultimate reimbursement well into the future.

It is not necessary to plan for even the majority of transmitters to interest themselves in color at this stage. The first step seems to be the encouragement of at least one station in strategic areas throughout the country, so that set buyers will have something to see.

BRIEF PROGRAMS

In New York, color programs are avialable for only short periods throughout the day. but Chicago has the first of a number of stations which will use color all the time whenever it is possible to do so. I doubt whether there are any color transmissions yet on the West Coast, although they are projected, and the total number of stations at the moment is comparatively small.

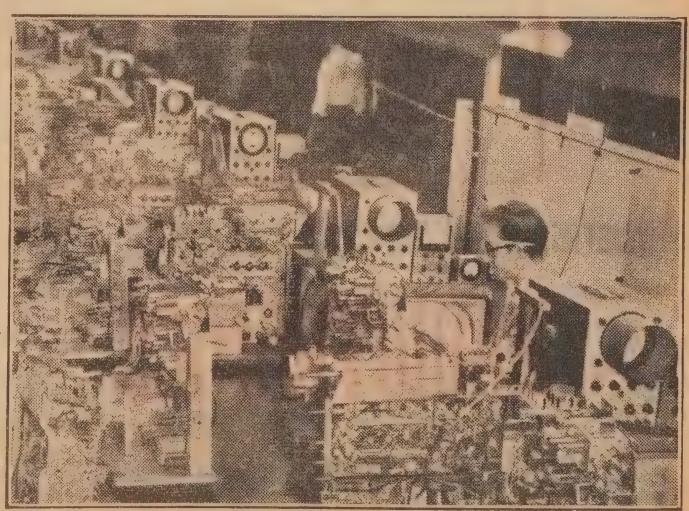
It is probable, also, that RCA is not making very much out of its receiver program. I feel it is much more interested in getting sets into homes than making profits.

At its Indianapolis plant it has a production line working on color sets in which every effort is being made to simplify both design and construction.

Many of the sub-assemblies use printed circuits which are fabricated on the premises, and many of the assembly operations are on an automatic basis.

It is quite intriguing to watch small resistors and condensers mounted to the printed strips by machines, which cut the pigtails to length and thread them accurately through the mounting holes. Some of the larger components are still added by hand, after which they are all soldered in place in automatic dip-soldering baths at the end of the line.

(Continued on Page 31)



A small section of the assembly line at Bloomington, Ind., where RCA 26-valve color TV receivers are being built and tested for the US market.

for the latest news on

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ONE-MAN PORTABLE TV STATION

adical new transistorised mini-ure television camera and rtable transmitter for spot ws telecasting and other TV ld pick-up functions has re-ntly been announced by the dio Corporation of America.

VELOPED at the David Sarnoff Research Centre of RCA in Prince-N.J., the experimental equipment cribed by RCA scientists as perhaps ost compact, complete system yet ed for picking up and trans-g television pictures.

includes a 4lb camera equipped a novel electronic view-finder, and b back-pack transmitter capable nding TV signals to a base station than a mile away.

st scheduled use of the equipment y the NBC to give improved tele-coverage of the national political ntions, beginning with the Demo-National Convention in Chicago ugust 13.

ANCED DESIGN

use of portable cameras and trans-s for news coverage was pioneered CA and NBC at the political con-ns in 1952, with equipment far dvanced technically than that an-ed today.

developmental transistorised a and transmitter were designed RCA research team working under idance of Dr. Vladimir K. Zwory-lonorary Vice-President of RCA.

Zworykin described the new a and transmitter as "major ements in broadening the flexibility vision as a highly effective tool for ing and instantaneously transmit-nformation from practically any on."

emphasised that the equipment is y transisttored, with the exception e transmitting and pick-up tubes. ty transistors are used in the en-sembly. Dr. Zworykin pointed out major contribution to the achieve of the new equipment was made CA's program of transistor de-nent, particularly in the field of requency transistors.

transistorised camera is built d a new RCA-developed Vidicon ion camera tube only ½-inch in ter, no longer than a king-size tte, and employing any standard motion picture camera lens.

H SENSITIVITY

ipite of its small size, the develop-l tube has a sensitivity greater that of the standard 1-inch Vidi-pick-up tube commonly used in le TV cameras. The tube, employ-n improved light-sensitive surface, eveloped at the David Sarnoff Re-Centre.

With camera held high to see over spectators' heads, the cameraman can watch proceedings through his electronic viewfinder, seeing the picture as distant viewers will see it.

The camera is equipped with a novel electronic view-finder which can be detached from the camera and hung around the cameraman's neck. Since it is electronically synchronised with the camera, the finder displays a scene as viewed by the camera lens, even when the two elements are separated in this fashion.

ELECTRONIC VIEW-FINDER

As an example of how this feature would be used, it is pointed out that the cameraman could look down into the view-finder to observe a scene being picked up by the camera, while the camera itself is held overhead to see over a crowd or other obstacle.

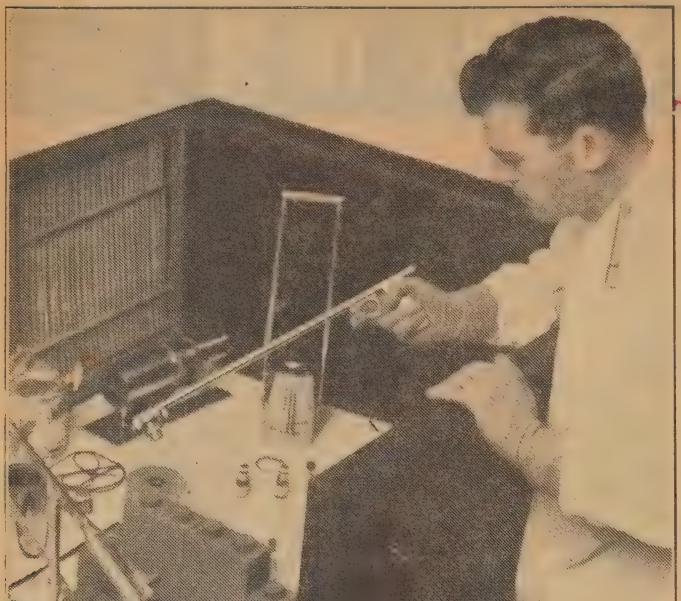
Exclusive of the view-finder, the developmental camera is only 2¼ inches high, 3 inches wide, and 8¼ inches long. All necessary circuitry and controls are contained within this compact unit, which feeds directly into the back-pack transmitter housing a synchronising generator, transmitter and power supply,

COMPLETELY PORTABLE

The back-pack transmitter, also completely transistorised, weighs only 15 pounds, complete with batteries, as against approximately 50 pounds for previous portable transmitter equipment with tubes. The pack is 12 inches wide, 13 inches high and three inches deep.

The batteries employed with the unit can operate the camera and transmitter for about five hours, in contrast to the two-hour life of batteries employed with tube-operated equipment.

Developmental samples of RCA's new one-half-inch Vidicon camera tube will be made available to television camera manufacturers within a few weeks.



A radiotherapist at St. Vincent's Hospital, Sydney, protected by a lead wall, withdraws a radioactive isotope from its lead container.

PLENTY OF WORK FOR ISOTOPES

Radioactivity and isotopes are so much in the news these days that readers might be excused for passing over any article which deals further with them. But I'm going to take the risk here, because I find the subject most interesting.

by Calvin Walters

NOW it is not much use talking to people about radioisotopes unless we have it quite clear just what an isotope is in the first place and what makes it into a radioisotope.

Better men than I have had a go at trying to define an isotope, but unfortunately they never seem able to get away from difficult technical terms which themselves need explaining.

To think that I may be able to do any better may be just presumption on my part but, with the help of what I have previously read about it, I intend to have a go.

SAME ONLY DIFFERENT!

I read somewhere that "an isotope is something that is exactly like something else only it is different".

This seems a silly sort of a statement but, in reality, it contains some sense.

During the course of the centuries man has come to learn that all the materials with which he is familiar—and some with which he is not familiar—are made up from a combination of any two or more of 92 substances which are called elements. For instance, water is made from a combination of the elemental gases hydrogen and oxygen. Common salt is made of the elements sodium and chlorine and so on.

The elements themselves are considered as being pure and, for a long time, it was thought that all hydrogen was alike, that all carbon was alike and so on right through the list of 92 elements.

It was found that this was not true and that in many cases there are differences which extend to the very atoms which are a constituent of single elements.

The chemical properties of these different atoms are indistinguishable f the basic element but they beh physically in different ways.

The difference lies mainly in weight of the atoms. Some are lig and some are heavier. But the difference is their ability to emit ra active rays.

Thus all hydrogen is not like other hydrogen. All cobalt is like all other cobalt and so on.

It was necessary to find a name these special kinds of elements so British scientist Frederick Soddy, was mainly responsible for estab ing the existence of them, called t "isotopes" from the Greek w ISO meaning "same" and TO meaning "place".

Thus it is that the "silly" defin given above assumes a more character for "an isotope is r something exactly like something only different".

You will always find, when rea anything about isotopes, that a par lar isotope has a small num attached to its symbol.

Thus you will see Hydrogen 1 Hydrogen 2 (H2) and so on with elements. This number represents

number of particles in the nucleu one of its atoms.

There is Uranium 233, 234, 235 238 which is of great importan us, as these are the substance which basic atomic energy rests. nium 235 is so far the only subs occurring in a natural state atoms can be subjected to fission. nium 233 is also a fissionable subs but it is a man-made one.

IMPORTANT DIFFERENCE

Non-radioactive isotopes can on distinguished from other kinds o same element by complicated app in the laboratory, but a radioactiv tope can be easily distinguishe means of instruments like the counter.

With the advent of the nuclear tor it became possible to convert elements into radioactive isotop merely exposing a given eleme the bombardment of neutron pa generated in the reactor.

This bombardment knocked the of the element around in such that the element itself became

e and emitted rays of its own.
ese elements are then known as
isotopes and are those which are
ig a revolutionary impact on chem-
biology and medicine today.
me of these radioisotopes are so
e that less than a billionth of a
nth of a gram can be detected
leans of a geiger counter.
can thus be seen that if a minute
tity of radioisotope is mixed with
uch larger quantity of the same
ent which may be essential to some
gical or industrial process, the
ess of that element through the
ss can be accurately traced.
leading biologist of the University
alifornia, Dr. Melvin Calvin, re-
y said, "As an indication of the
ive way in which these radio-
e materials assert their presence,
),000th of a gram of carbon 14
be accurately measured when
d through the tissue of 20,000
a pigs." (I quote this authority
ise his surname is the same as my
tian name and that must be some-
.)

NSE RADIATION

me radioisotopes emit rays of
intensity that they are capable of
rating many inches of solid steel
concrete. These isotopes are really
small portable x-ray machines
are used for a variety of purposes
n will be explained later.
e most useful characteristic of
active material is its spontaneous
ion of three types of rays, alpha,
and gamma.
e beta rays are really particles,
electrons, while the gamma rays
imilar to x-rays.
e beta particles are readily absorb-
r scattered as they pass through
material while the gamma rays get
gh readily.
a thickness gauge a source of
activity in the form of a radio-
pe is placed under the sheet to be
ured and a detection device above.
by a knowledge of the strength
he source, a measurement of
umber of rays getting through the
can be interpreted in terms of the
ness of the material.
ta gauges are useful for thick-
s up to about one quarter inch of
or plastic, 1/16in aluminium or
in steel.
mma rays are used to measure
hickness of several inches of steel.
source of the beta particles is
ly radio strontium, caesium or
um. For gamma rays the source
ually cobalt or caesium.
other type of gauge is applied to
side only of a material that is be-
coated with something else, such
cquer, plastic and so on. In this
the rays reflected from the base
rial are measured and thus a
is kept on the thickness of the
ed material.
will be obvious that this type of
uring has great advantages, as a
sealed capsule of the isotope is
insensitive to severe operating
itions such as vibration and elec-
interference.
considerable amount of publicity
given recently in Sydney regarding
children who suffered from a dan-
gerous dose of radioactivity, after having played with a radioactive cobalt capsule. It had been used for detecting flaws in the welding of pipes and had inadvertently been left lying around.

Fortunately, the children recovered but the incident stimulated interest in the use of these isotopes which, although now being used to an ever-widening extent, are not familiar to the general public.

I refer to the application called radiography using radioisotopes instead of the more cumbersome x-ray equipment.

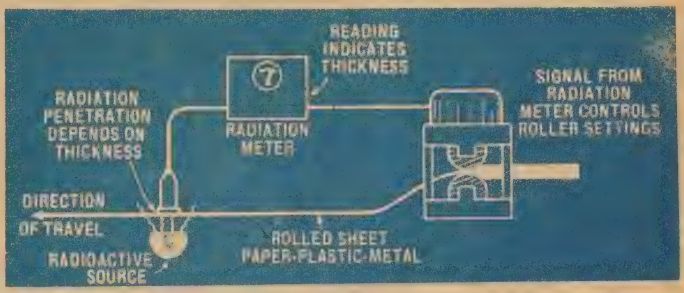
This method is particularly useful in the inspection of castings and can detect such things as inclusions of foreign material, shrinkage and cracks. It is also of great use in inspecting welds to see if the weld material has properly penetrated, whether there has been lack of fusion, whether any slag has been included or if there are cracks.

The method of inspecting castings can save considerable sums of money by detecting faults in castings which are often otherwise not found until considerable expense has been involved in machining.

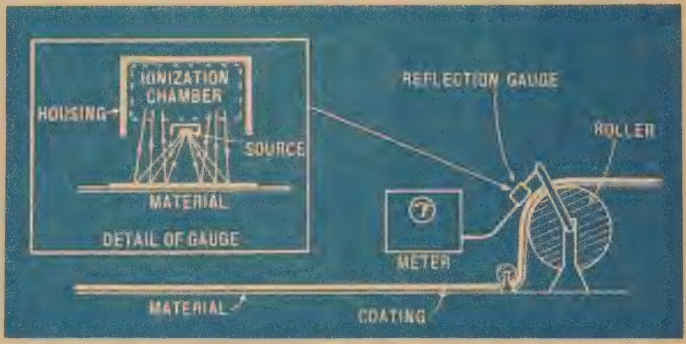
Radiography is also used for inspecting forgings or even complete assemblies. In practice, it is often possible to detect individual defective parts without having to dismantle the complete assembly.

The source of the rays is usually a radioactive isotope of cobalt. This is contained in hermetically sealed capsules of aluminium or stainless steel about 2in long and ¾in in diameter.

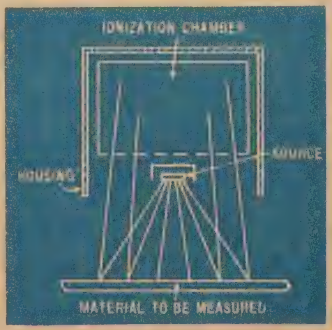
When not in use the capsules are kept in a lead container of considerable thickness for protection against radiation.



A conventional thickness gauge operating on the beta absorption principle. Sources of beta particles in common use are radioactive strontium, caesium and thallium.



Illustrating the principle of the back-scatter thickness gauge, used for measuring the thickness of a material or coating where only one side is readily accessible. The diagram below shows the measuring head in greater detail.



TRACER TECHNIQUE

The usual method of handling is to house the capsule in a lead container in the bottom of a cabinet. The cabinet is provided with a flexible goose-neck cable which is positioned inside the pipe or casting at the position where it is desired to hold the capsule for photographing. The capsule is then reeled out to the end of the goose-neck, the photo taken and the capsule reeled back again into the lead container.

Another simpler but more cumbersome method is for the capsule to be provided with a long chain. The operator picks this up with a pair of

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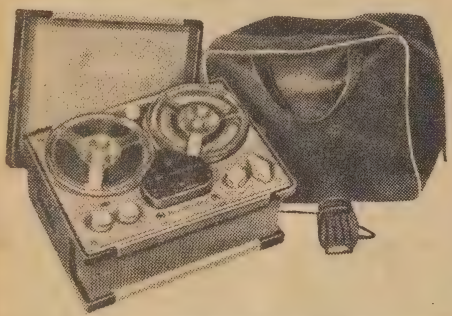
(illustrated) The SMALL RECORDER with the BIG PERFORMANCE



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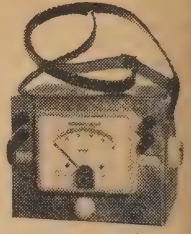

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ong tweezers, puts the capsule in ion, takes the picture and places capsule back in the lead box.

ie use of radioisotopes as "tracers" iow widespread in industry and cine. This method makes use of ie quantities of radioactive material duced into any system or process eby the flow of the element igh the system can be followed by is of a detector like a geiger ter.

interesting application of this od is in the detection of leaks in joints of freshly laid water mains. idioactive sodium is usually used his purpose. A solution of this is into the pipes and then raised to iormal operating pressure. If there iny leaks in the joints or elsewhere solution will seep through the leak the surrounding earth. The radio- e solution is drained from the main replaced with clean water. A ter inside a metal probe is then d into the soil along the length of nain.

iy residual radioactivity in the soil adily detected and this indicates a at that point.

LTY OIL PIPES

new method has recently been ed of detecting leaks in long oil lines. For this a unit containing tector and wire recorder is towed inside the pipe by the oil. At the of a few miles of pipe line the unit noved and the wire recorder played when the position of any leaks stantly revealed.

ie tracer method is exposing the ess of wear and tear throughout ie ramifications of industry.

rendering the piston rings of a notor radioactive in a reactor the it of wear taking place in a motor ie measured by measuring the radio- ity of the oil in the sump brought t by the particles of radioactive from the piston rings mixing with oil.

ie wear of motor tyres on starts, , skids, curves and straight roads iow being measured by mixing phosphorus with the tread rubber. hen measuring the radioactivity of road surface over which the tyre passed the wear of the tread can ieasured directly without the tedious consuming methods of the past.

ear of gears, which is a measure ie quality of the material of which gear is made, is measured by ren- g the gear radioactive and measur- he activity of the oil in the same as the aforementioned piston rings

tool steels contain cobalt, tung- tantalum and chromium, it is easy nduct researches into the best type lloy for these tools by rendering elements radioactive. The amount ear is determined by measuring the ity of the dust coming from the while in use. Thus we have a very ent aid to quality production.

iickness gauges are now being used ie manner described in the early of this article, to measure and ol the thickness of cigarettes as come through the machine. A od has been devised actually to control the machine by means of this gauge so that the thickness of all the cigarettes will be uniform.

COSMETIC TESTS

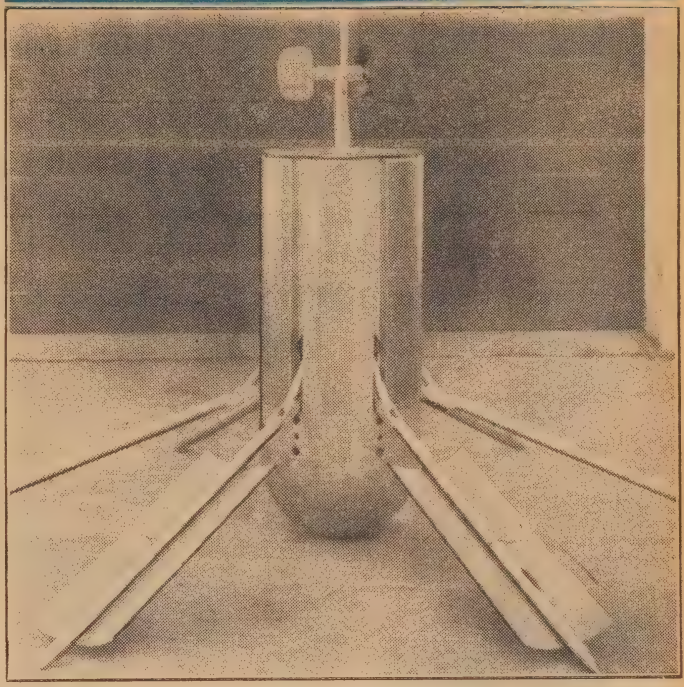
By means of tracers using radio-isotopes, the cosmetic industry is able to determine how long a particular cosmetic stays on the skin or how effective a dentifrice is in inhibiting tooth decay.

One sees a danger here. One can easily imagine a woman of the future using some particular lipstick containing a radioisotope then testing hubby's handkerchief with a geiger counter to find out if the lipstick on it was hers or otherwise.

In the food industry where mixing processes take place, radioisotopes are used to control accurately the correct mix and the time involved. There is no danger of the isotopes causing danger to the consumer of the goods, as the tracers used are those having a very short life span of only a few minutes. They decay rapidly and have no effect whatever on the foodstuffs being manufactured.

Much has been written previously about the use of tracer isotopes in medicine where it is used to trace the progress of certain vital chemicals through the human body so I will not touch upon that subject here.

"GRASSHOPPER" WEATHER STATION



This US Navy "Grasshopper", one of nine being built at the Indianapolis Naval Ordnance Depot for Antarctic use, is an airborne weather station. Dropped from a plane, it shoots out six legs and a 20ft antenna, then broadcasts weather data for six months without servicing.

There is an interesting application, however, and an amusing one in some ways, which goes to show that even the privacy of the humble mole or rabbit is being invaded by modern atomic science.

VALE, MR. MOLE

In England the mole causes considerable damage to pasture fields by its incessant tunnelling under the surface. When he is down there, he is hard to find and you don't know just to what extent he has undermined the field.

Now you find his home and his missus and his family by first catching him in a trap and fastening to his leg little rings containing radio cobalt and letting him go. Then you take a geiger counter fastened on to the end of a long bamboo pole. You use a pair of headphones to listen for the clicks and while moving forward the pole is swept over the surface of the ground. By listening for the clicks the course of the animal can be traced until you finally find the nest. You can then dispose of him and his family in an appropriate manner.

This method also plots the extent of his ravages, because the counter follows him through the tunnels. No one is safe nowadays are they?

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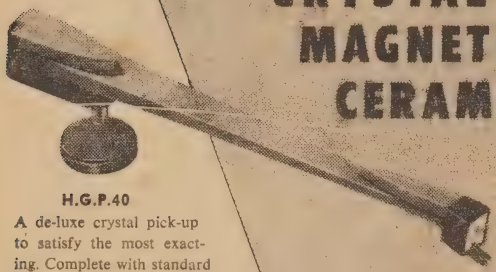

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PRICE **£9/15/-**

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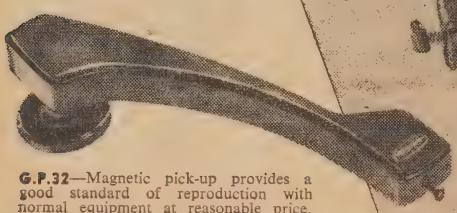

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Technical Review

ALVES AND TRANSISTORS FOR HYBRID CAR RECEIVERS

Mention was made in our last issue of "Hybrid" car radios—receivers using a combination of valves and transistors and designed to operate directly from a 12-volt electrical system. Literature to hand from the Tung-Sol Company, gives details of their valve-transistor combination designed for this application.

HE Tung-Sol Company claims that, by using their new range of valves their "Golden Heart" transistor, it ossible to eliminate fifteen vital parts n a car receiver, including the en- vibrator high-voltage supply. eliability is increased and the total ent drain is reduced by one half. thermore, the same order of gain performance is available as from a ventional receiver using high volt- s.

he accompanying table shows the racteristics of the new valves.

ype 12AC6 is an RF amplifier pen- e, capable of operating with 12.6 s on the heater, screen and plate. n though the total plate and screen rent is only 56 microamps, the trans- ductance is 730 micromhos, which is the same order as for battery pent- s operating in conventional portable eivers.

he 12AD6 is intended for converter vice, again at 12.6 volts, while the AE6 is a diode-triode for detector- plifier service.

While these valves represent an ievement in themselves, the manu- turers stress that one of the chief blems in hybrid set design has been translate the signals from the essen- ly high impedance circuits following detector into a form where they can ve audio type transistors, with their entially low input impedance.

As a solution to the problem, Tung- have developed the 12K5, low-volt- tetrode power amplifier. Though l operating at only 12.5 volts it draws otal cathode current of 93 millamps has a transconductance of 7000 micromhos.

To achieve these figures, Tung-Sol have resorted to the "space-charge" principle, as used in very early battery tetrodes. The same idea has been used through the years to make valves like the 6J7 operate in simple regenerative circuits from 6-volt supplies.

The space charge effect involves applying a positive voltage to the inner grid, thereby initiating a high grid current but, at the same time making available a liberal supply of itinerant electrons for subsequent use.

The signal is applied to the number 2 grid and controls electron current to the plate.

The 12K5 applies these general principles to achieve high transconductance, low output impedance and sufficient output power to drive a power transistor. Tung-Sol's type TS-176 transistor is rated to draw 500 milliamps at minus 12 volts and has a power gain of 30db.

NO TRANSFORMER

With a source impedance of 15 ohms, it will deliver a power output of 2.5 watts at 8% distortion into a 30-ohm load. It thereby eliminates the need for an output transformer, being capable of operating directly into a high-resistance voice coil.

Tung-Sol claim that their products enable a practical hybrid receiver to be designed, which will have higher overall gain than one using conventional techniques. Gain figures quoted are as follow, those in brackets referring to a conventional receiver: RF Amp 125 (500); Mixer 25 (40); IF Amp. 50 (100); Audio Amp. 20 (5).

TYPE	Heater Voltage	Pla Voltage	Grid 1 Voltage	Grid 2 Voltage	Grid 3 Voltage	Plate Current	Grid 1 Current	Grid 2 Current	Transcond. Control G-P	Triode Mu.
2AC6	12.6	12.6	0	12.6	Cathode	28uA	—	28uA	730 umhos	—
2AD6	12.6	12.6	1.1 rms	12.6	0	120uA	30uA	650uA	100 umhos	—
2AE6 riode	12.6	12.6	0	—	—	750uA	—	—	1000 umhos	15
iodes	12.6	10	—	—	—	2mA	—	—	—	—
12K5	12.6	12.6	12.6	-2	—	8mA	85mA	—	7000 umhos	5.6

High Freq. Power Transistors

THE Philco Corporation have recently announced the release of high frequency transistors as a standard line and meeting standards laid down by the US Army Signal Corps.

Designated as types 2N128 and 2N129, they employ the surface barrier principle.

Philco claim to have beaten most of the problems which have hitherto attended the production of high frequency type transistors. They claim to have achieved excellent frequency characteristics with uniformity from one transistor to the next, a high degree of reliability and complete sealing against atmospheric penetration.

They envisage that release of the new high frequency transistors will make possible the design of new communication equipment, without the weight and power supply problems which attend valve-dependant circuits. Much smaller, completely self-contained handset transmitters should be possible.

Another interesting transistor development, representing just the reverse kind of research, is an announcement by Sylvania of 60-volt power transistors. Also sealed against atmospheric penetration, these power transistors are designed to operate where moderate voltages are readily available, as in aircraft and where higher power is involved than can be handled conveniently by conventional transistors. Types 2N141 and 2N143 are PNP 60-volt types with an average dissipation rating of 4 watts.

UNITED RADIO DISTRIBUTORS Pty. Ltd.,

Showrooms and Counter Sales. 175 Phillip St., Sydney

AUTOMATIC MONITOR FOR MAGNETIC SOUNDTRACKS

A system developed by MGM and described recently in "Electronics", makes possible rapid, automatic checking of the magnetic soundtracks on CinemaScope films.

BEFORE the advent of magnetic sound tracks, inspection of one ical track on each reel was a relatively ple matter. Since magnetic modula- is not visible and there are four arate tracks on each reel of Cinema- pe film, a change in control and in- ction procedure became a necessity. The obvious method of actually run- g all prints in a projection room was sidered to be too slow and too costly. velopment of an automatic electronic thod seemed to be most practical. By adding monitor heads to both master reproducer and the copying order (printer), in the same relative itions, audio signals can be compared l differences indicated.

Since the photographic picture is eady on the film in the sound print- procedure, a stroboscopic viewer alled in the correct position on the nter also permits checking of syn- onism of sound and picture. In s manner, prints are automatically pected during the printing operation little cost and with no loss of time. Figure 1 is a block diagram of the mplete printing system. Since the nparison method is the same for all r tracks, only one equipment chain illustrated. Furthermore although master magnetic reproducer gener- s signals for several printers, only is shown.

STANDARD EQUIPMENT

Except for the comparator section h its error indicator and the strobo- pic generator, standard equipment used.

The master reproducer has two sets reproducing heads. One set feeds o the normal transfer channels com- sed of reproducer amplifiers, Y-pads, ording attenuators, recording ampli- s and recording heads at the printers. About two inches below the normal roducing heads is placed a set of nitor heads. These heads serve the al purpose of supplying audio signals standards for the comparing cir- ts and for direct audio monitoring. A set of monitor heads on the printer, the same relative position as above. ds signals from the print to the com- ring circuit as well as the print- nitor network.

The 4-db loss pads isolate the com- ring and monitoring sections.

On the visual side, the stroboscopic erator pulses the Strobotron at 24 s so the picture can be viewed ile printing. The strobotron is ced exactly 28 frames below the nter monitor-head assembly, so the dio monitor will be in exact syn- onism with the picture observed. is displacement corresponds to the ndard CinemaScope offset between nd and picture.

Circuit details of a comparator are en in Fig. 2.

This circuit accepts the master moni- and print monitor signals through

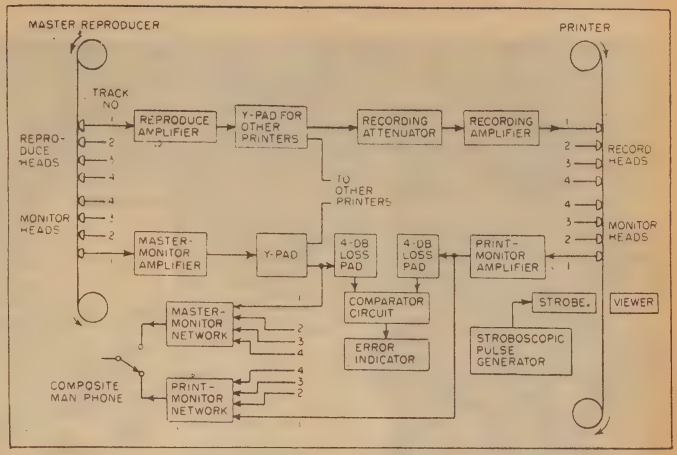


Figure 1: Each track of the system has its own channel, recording head, monitoring head and comparator unit. All refer back to a common master monitor. Note that the heads are mounted side by side in practice, not as shown in the diagram.

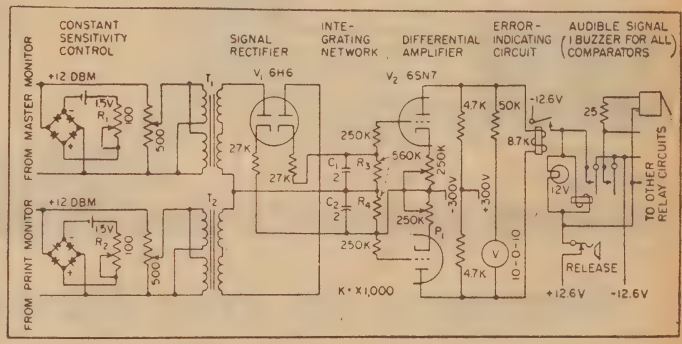


Figure 2: A schematic of the comparator and error-indicating circuits. Input level to the comparators is plus 12db when the magnetic track is modulated 100 per cent.

identical channels, each consisting of a constant-sensitivity control ahead of the input transformer, a diode rectifier and an R-C integrating network.

The algebraic difference of these integrated voltages is impressed on one grid of the differential amplifier while the other grid is held constant by the voltage drop in its corresponding cathode resistor.

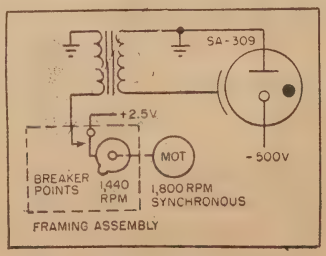


Figure 3: Details of the stroboscopic viewer.

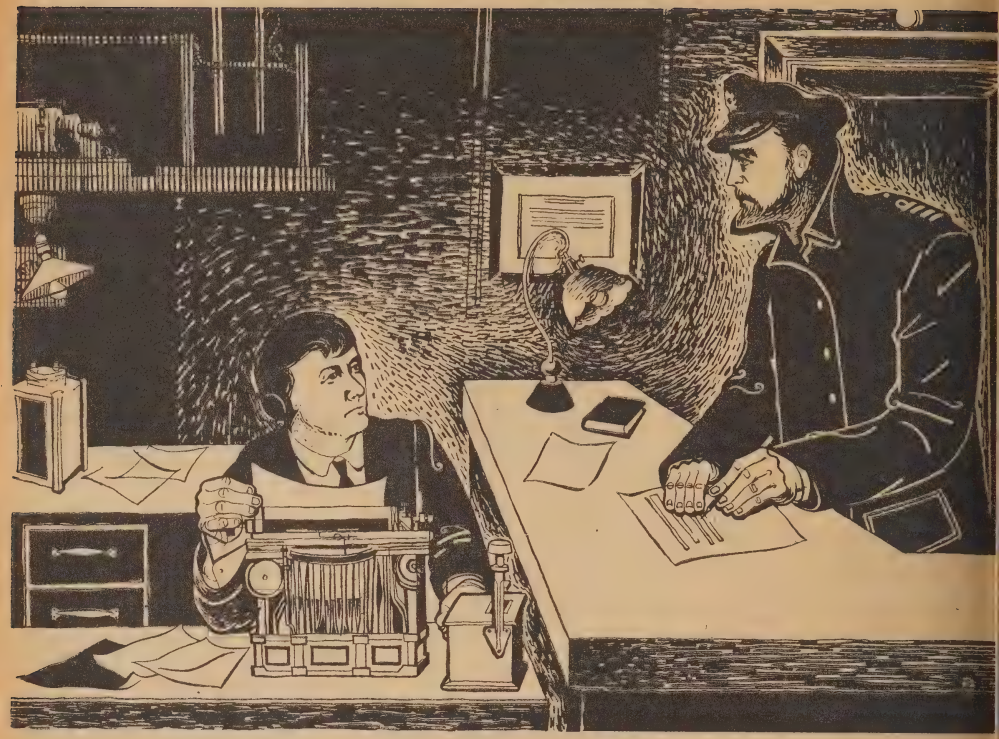
A sensitive relay, together with a zero-centre voltmeter in series with the resistance, is connected between the two plates of this amplifier. The meter indicates the sense and amount of error voltage continuously, while the relay operates a buzzer and signal light when the error exceeds a predetermined value.

Details of the stroboscopic viewer are given in Fig. 3.

The 24 cycle triggering pulse, necessary for proper stroboscopic viewing, is obtained by driving a standard automobile distributor breaker and ignition coil with a small synchronous motor geared to 1440 rpm. The mechanical arrangement of cam and breaker points is such that their relative angular position can be varied to frame the picture in the field of view.

For the sake of simplicity, certain restrictions were imposed on the comparator circuit in the matter of time constant and dynamic range. This makes the equipment insensitive to small inevitable phase shifts due to

(Continued on Page 79)



Danger in the Deep . . .

"Send SOS; it's the new call and it may be your last chance to send it!"

The suggestion was made in the wireless room of a ship everyone believed was unsinkable.

A radio officer looked up and laughed.

The time was 12.45 a.m., the date, April 15, 1912, and the sinking "Titanic" sent out the first SOS in history.

Today, a danger as disastrous to shipping as an iceberg is — ***rust.***

Rust is costing Australia more than £3 every second of the day.

Oil coatings* have now been devised which protect metals from corrosion. Manufactured by SHELL, they vary from thin, oily films suitable for short periods, to thicker, grease-like films for longer protection.

With such coatings Shell is helping Australia to remove the £100 million rust-stain from the balance sheet of the nation.

**Shell Ensis Oils.*

ICKEL-CADMIUM BATTERY CLAIMED AS WORLD'S BEST

new battery manufactured by the French Societe des Accumulateurs Fixes et de Traction AFT) is claimed to be "the finest battery for the most demanding tasks". It is the new ermetically-sealed, nickel-cadmium Voltabloc, being adopted for use in combat aircraft.

1948, the research staff of the S.A.F.T. company perfected the pro- on of very thin plates of alkaline bat- by a sintering process. The cells of batteries were capable of developing n a reduced volume and weight, derable instantaneous outputs at a rkably stable terminal voltage. r the first time they allowed use of kaline cell within the space occup- y the traditional lead-acid battery.

IMS FOR BATTERY

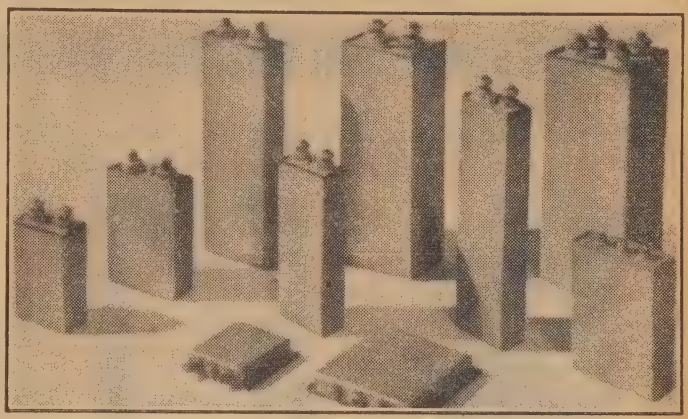
e resulting "Voltabloc" battery:
an start all kinds of engines (piston urbine).
as the lowest internal resistance of alkaline battery made anywhere. internal resistance of a 35 Ah cell 35] is about one thousandth of one)
an be charged below the electro- g point of the water; hence it oper- in a sealed container and needs no topping.
perates as either a buffer or floating ry.
ives a considerable ratio of power olume and weight.
rovides extraordinarily high peaks rrent.
Operates satisfactorily in very low eratures and at very high dis- ge rates.
aries little in capacity with the dis- ge rate.
Maintains a substantially constant of discharge voltage.
suitable for continuous charging at xceedingly low rate.
las a high performance reliability.
Has demonstrated a watt-hour effi- y materially constant during endur- tests, and superior to any other mulator.
s chemically and mechanically in- uctible — secure against any break- due to vibration, stress or mechan- impact.
Requires no maintenance.
May be stored away in any state of ge, and put back into service after nple recharge.

US ORDER

hree years ago the US Navy's au of Aeronautics placed a million ar order for 2000 of S.A.F.T.'s el-cadmium aircraft batteries. The ion to buy the French batteries came 15 months of intensive tests by the Bureau of Standards, and by the y in operational aircraft at its test on in Patuxent, Maryland. The eries met all Navy specifications, and some phases, exceeded all expecta- ."

s a result of these successful tests, y officers predicted that 'before long new nickel-cadmium batteries ld replace lead-acid batteries in all ary aircraft. **Aviation Week** re- ed at the time:
Until now, the lead-acid battery has the weakest part of an aircraft's rical system. The best lead-acid batteries are not serviceable beyond 100 hours.

"There is a strong possibility, that the nickel-cadmium battery will last for the life of the aircraft. If so, it would become the strongest point in the aircraft's electrical system rather than the weakest."



A group of "Voltabloc" nickel-cadmium accumulators.

BRITISH, FRENCH TESTS

After extensive tests by the famed Farnborough Laboratories, Britain's Royal Air Force and Royal Navy also placed orders for "Voltabloc" batteries.

"Voltabloc" today is standard equipment on top-performing French aircraft, including the "Caravelle" and the "Leduc" experimental jet.

In "starting" tests with three F-84 "Thunderjets" in an ambient temperature of zero degrees, carried out in succession without recharging the batteries, ignition took place in about 30 seconds and the complete starting time was about 60 seconds.

After 1500 hours flying time in French Equatorial Africa, with no maintenance, the "Voltabloc" went straight back into service after a simple "dusting down".

Electricite de France (E.D.F.) uses the new battery extensively for switchgear control and relay feeding

The French Navy uses it in starting power units, security lighting, and switchgear control

The French Army uses it to start various power units. Recent tests proved it efficient even at minus 30 degrees Centigrade.

The SNCF (French National Railways) uses it in starting diesel engines and in signalling.

Explorers like Captain J. Y. Cousteau (see The Silent World) use it on their underwater scooters.

French coal miners now use it in their portable lamps.

A "Voltabloc" cell consists of a set of sintered plates in a steel container provided with a welded cover carrying the positive and negative terminals.

The plates consist of a strip of nickel-plated perforated steel, on to which is sintered a base of extremely porous nickel. The plates are impregnated with the active material, i.e., nickel hydroxide for the positive plate, cadmium hydroxide for the negative plate.

The insulation between the positive and the negative plates is insured by an insulating fabric, which successively envelopes all the plates of the set, and by a plastic envelope which gives perfect insulation between the plates and the container.

Each positive and negative group is interconnected by a soldered busbar carrying the appropriate terminal.

EARLY RESEARCH

The search for an alkaline accumulator with invariable battery solution (electrolyte) has been intensive through the past 70 years. The fundamental patent was taken out in 1893 by G. Darrieus.

After numerous theoretical and practical tests which lasted until about 1908 thousands of ferro-nickel batteries were put into service in the United States, Britain, and the Scandinavian countries, where the alkaline accumulator began to be highly regarded.

S.A.F.T. became the first company to mass produce sintered plate batteries in 1948. Four years later, the company developed the production of thin, sintered plates in continuous strips of a few hundred yards, instead of the previous "plate by plate" method.

S.A.F.T. today is the world's largest producer of alkaline batteries. Its two main types are the traditional ones with punch-steel strips pressing the active materials together, and the new-style thin sintered plate "Voltabloc."

(From "France Actuelle").

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The ideal cabinet combination for High Fidelity Reproduction at a reasonable price.

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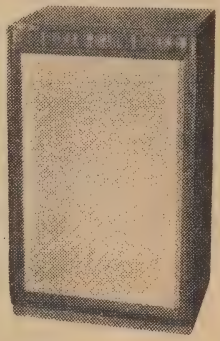
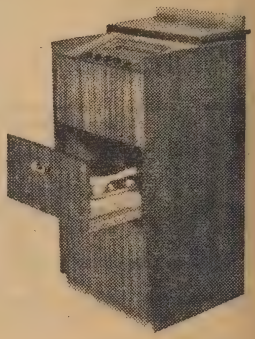


VENTED ENCLOSURE



MODEL "B"

The vented enclosure is scientifically designed and constructed of highly polished veneer ¾in laminated ply lined with heavy felt. Front is covered in matching tapestry. Suitable for most 12in speakers including Jensen M.S.P. duals, Rola, and Magnavox.

PRICE £22-10-0

F.O.R. (packing 25/- extra)

The radiogram cabinets are constructed of highly polished ¾in laminated ply and fitted with piano hinges and hydraulic closers. Two cabinet designs are available. Model "A" has the record changer on top and pull-out compartment with hydraulic closer for chassis.

In Model "B" the chassis is fitted on top of cabinet with the dial at a slight angle covered by a hinged panel and the changer is fitted in a sliding drawer.

Record space is provided in both models.

PRICE Model "A" £25/15/-. Model "B' £23/15/-.

F.O.R. (packing 25/- extra.)

CABINETS AVAILABLE IN THE FOLLOWING FINISHES: ROSEWOOD, MAHOGANY, WALNUT WITH INTERIOR FINISH IN CONTRASTING ASH OR CONTEMPORARY MAPLE FINISH WITH SWEDISH TYPE BASE.

Cabinets may be polished to match any furniture where sample of colour is supplied at slightly higher cost.

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Compare these new features of our Hi-Fi nine valve D.W. radio-gram chassis with dual triconed speakers and separate bass and treble boost.

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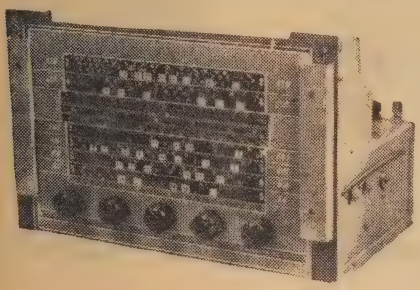
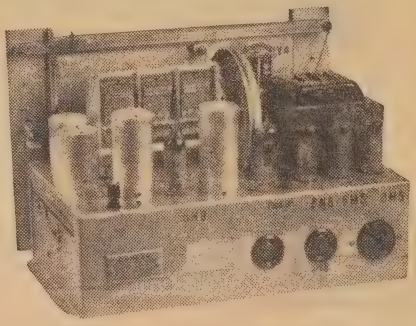
Frequency Response 40 to 13,000 Cycles — Max. Output 10 Watts.





NEW ● Ultra modern circuit using nine high gain valves including "magic eye" tuning indicator. Permatuned iron cored coils and intermediates giving excellent interstate reception and a short wave range of 12,000 miles. All valves used are the new Philips nine pin innoval series.

NEW ● Tone control and audio stages incorporating the Mullard 5/10 amplifier circuit with separate bass and treble controls giving + or — 15db. boost or cut at 50 cycles L.F. and 10,000 cycles H.F., combined with push-pull output with inverse feed-back gives you really high fidelity reproduction from your radio or favorite recordings.

NEW ● Dual speaker combination using a heavy duty woofer (12in M.S.P. Jensen AU54 special) with matching 6in tweeter and cross-over network giving a frequency response of 46 to 13,000 cycles. Speakers are mounted coaxially making only one 11in mounting hole necessary. If required the new Magnavox high fidelity twin coned speaker can be supplied.

NEW ● Large calibrated edge-lit dial in plate glass (11in x 7in) with main stations of each State in prominent type. Dial fitted with counterweight drive giving smooth tuning. Indicator lights are fitted showing which band is in operation. Dial can be supplied in cream, black or brown with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

NEW ● Sensitive 'magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate, overseas and country stations

All chassis are wired for the fitting of an F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for gramo. motor.
Power switch is fitted to volume control, radiogram switch combined with wave change switch. Audio end of set can be used with T.V. receiver if required

ALL CHASSIS GUARANTEED FOR A PERIOD OF 6 MONTHS

A New 10-Valve Dual-Wave Radiogram Chassis

WITH BASS AND TREBLE BOOST

The ideal chassis for those difficult locations where reception is doubtful. Specifications as nine-valve unit but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short wave bands.

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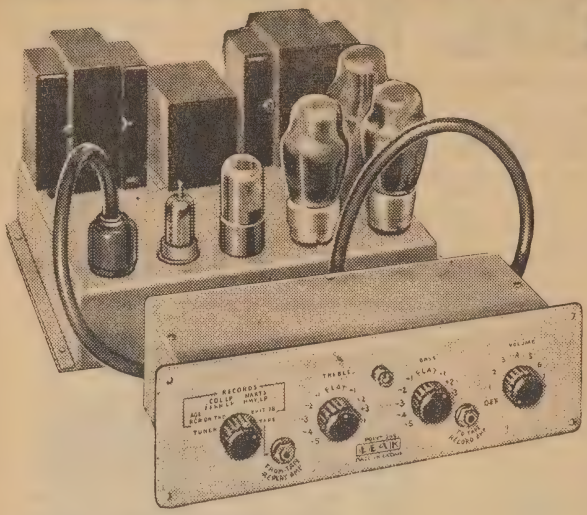

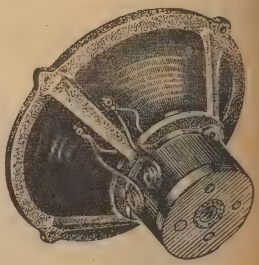

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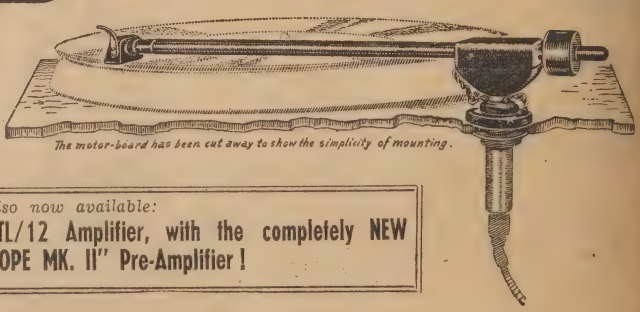

The motor-board has been cut away to show the simplicity of mounting.

Also now available:

The World-Famous LEAK TL/12 Amplifier, with the completely NEW "VARISLOPE MK. II" Pre-Amplifier!

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★ Also recommended as THE ULTIMATE Wharfedale Twin—and Three Speaker Systems

NEWS AND VIEWS OF THE MONTH

BC relays

PORTS to hand indicate that there has been a major change in policy he Australian Broadcasting Commis- relative to interstate relays.

o date, major program features inating in a particular capital have relayed by landline for simultaneous state broadcast.

nder the new arrangement most of major concerts will be recorded on and broadcast over interstate net- ks on a subsequent evening. It is ned that the new arrangement should e for more economical operation is technically capable of better re- .

may also have the advantage that oncert which is missed one evening be available to a listener the fol- ng evening through an interstate net- k.

ew B/C stations

DVICE from the Australian Broad- casting Control Board indicates that t more medium frequency broad- stations have commenced operations re scheduled to do so by the middle 1957. The stations are as follows:

MG Mt. Gambier, 1580Kc, 200 watts ional station.
AL Albany, 650Kc, 400 watts, Nat- l station.
VA Albany, 1370Kc, 2000 watts, nmercial station.
GL Glen Innes, 820Kc, 10,000 watts. ional station.
WN Wollongong, 1580Kc, 2000 watts, ional station.
MV Renmark, 1590Kc, 2000 watts, ional station.
PA, Penola, 1160Kc, 2000 watts, ional station.
VM, Mooree, 1530Kc, Commercial ion.

When 2GL Glen Innes commences ration, National station 2NA New- le will be changed in frequency n 820 to 1510Kc.

elevision channels

ELEVISION channels which have thus far been allotted in Sydney as follows:

BN, National Station, Channel 2, 0Mc.
TN, Amalgamated TV Services Pty. ., Channel 7, 181-188Mc.
CN, Television Corporation Ltd., nnel 9, 195-202Mc.

Melbourne stations are:

BV, National Station, Channel 2, 0Mc.
SV, Herald Sun TV Pty Ltd., Chan- 7, 181-188Mc.
GTV, General TV Corporation Pty. ., Channel 9, 195-202Mc.

issile engine

HE Bristol Aeroplane Co. recently gave first news of a new revolu- ary aeroplane engine.
has passed all tests at Woomera cket Range.
ecent visitors to Woomera were not permitted to see the engine because it was on the secret list.

It is believed to be capable of propelling a missile at more than 1500 miles an hour.

The company's sales manager for Australia said tested missiles had to be prevented from flying beyond the boundaries of the firing ranges.

The new engine was named the Bristol Thor Ramjet.

It could be used for manned fighter aircraft and supersonic civil planes when these had been developed.

The ramjet principle was as big an advance on ordinary jet engines as the jet was ahead of the piston engine.

African station

THE Marconi 20kW H.F. air-cooled transmitter recently installed at Dar-es-Salaam, Tanganyika, is the most powerful operating in East Africa. It is installed in a new broadcasting station situated in a typical tropical setting amidst palm trees in Dar-es-Salaam.

In addition to the transmitter, Marconi's supplied a studio control console, program lines equipment, program input equipment, and the complete aerial system for the new station.

Drive-in comfort

BARRING blizzards, drive-in theatres may be able to operate farther into the winter, thanks to a new in-car heater announced in the US by RCA. The new unit, called the RCA Dyna-Heat, is a small and compact affair featuring calrod heating elements and heat radiating aluminium fins. It can be installed and suspended by a hanger on the theatre's individual in-car speaker post.

☆

Outside the offices of the ARRL at West Hartford, USA, are seen Byron Goodman WIDX, and Editor John Moyle VK2JU. "By" is one of the old timers at ARRL, and his technical articles in QST are known the world over.

New observatory

THE British and Australian Governments have built a modern meteorological observatory in a remote part of Western Australia.

The observatory is near the little-known Rawlinson Ranges, 140 miles due west of Ayres Rock, in Central Australia.

According to the Minister for the Interior (Mr. Fairhall) the primary purpose of the observatory is to provide weather data to help atomic tests at Maralinga and weapon tests at Woomera.

The British and Australian Governments will hold atomic tests at Maralinga, in the South Australian desert, later this year.

Mr. Fairhall said other purposes of the new observatory would be to:

- Plot the passage of rain-producing air masses from the Indian Ocean across Western Australia.
- Study jet stream—highspeed winds which travel across the continent at high altitudes and which have an important influence on aircraft operations.
- Provide weather information vital to the future development of the interior.

Mr. Fairhall said the observatory would benefit Australian weather forecasting generally.

Britain would contribute £75,000 toward the cost of the observatory and would supply special radar equipment.

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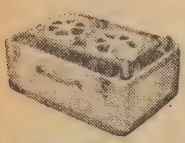

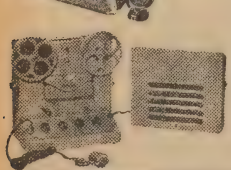

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HIRE A TAPE RECORDER FOR YOUR NEXT PARTY OR SOCIAL FUNCTION.

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MAGNETIC SOUND INDUSTRIES

GEORGE STREET (OPP. STRAND ARCADE) ON THE 1st. FLOO

PHONE: BX4440-BX4586

DITORS REPORT ON COLOR TV

(Continued from page 13)

he completed receivers are natur- much more complicated than the dard type, and must pose a sizeable dache to a serviceman who is not a qualified engineer!

he makers have their own reasons applying such intensive work to r TV program, and no one can ne them for their endeavors to con- date their own position in such a ly competitive field.

ut I think there is also the desire establish the present color standards solidly as to resist any suggestion modifications to standards can be de.

LOR STANDARDS?

doubt now whether any uniformity color standards throughout the ld will be possible or even practic- e. America at any rate shows as le interest in the subject as it does uniformity in monochrome.

Moreover American engineers do not ognise that even in monochrome re is any "world standard" other n their own 525-line system.

They argue that the 625-line system suggested by the CCIR, and opted by all newly equipped coun- es outside the American influence, not a standard at all, but merely a ommendation. And as the American up has about 10 times as many sets erating as the rest of the world, they y have a point.

It is far more likely that America, itain, France and the rest of the rld will persist in their present tech- ques, extending them at the appro- ate time for color, and taking ad- ntage of the compatibility that this ll allow.

The problems of converting from e system to another in international ok-ups seem likely to remain, to be ved in the future by similar methods are now used for monochrome.

UBLIC REACTION

How is the public reacting to the roduction of color, and how anxious it to buy receivers?

To date I think the response has en slow, and must be somewhat appointing to the trade. It is true at color has not been available in a rkable form for very long, and then ly in USA, but even so the com- rative rate of expansion has not been eat.

And while I personally am very in- gued with the potentialities of color, at does not mean that the rest of e world will be equally enthusiastic.

The impact of monochrome has not t spent itself as a means of giving service good enough for the average an.

In fact I have been impressed with e fact that the public will apparently cept even poor quality reception as ng as the pictures move, and their in- rest is centred upon the action. I nnot help feeling that many tech- cal discussions and criticisms of trans- itted pictures may be perfectly valid on their own grounds, but are not appreciated in the same way by the public.

This is borne out by the fact that even good quality American sets are not engineered to make use of the full available bandwidth of the transmis- sions. It is cheaper to make them that way, and the public appears perfectly satisfied with something below the best that can be done.

It may be significant that the coun- tries in which engineering standards are watched most carefully, not for- getting the French insistence on the astronomical 819 line system, are those in which commercial TV does not oper- ate, the services being supplied and paid for through government channels.

It will be interesting to see whether the introduction of commercial TV in Britain will affect engineering in that country, although with the compara- tively modest demands that British TV makes upon technique, the impact may be slight.

I cannot imagine that, in the fore- seeable future, color could ever sup- plant black-and-white entirely.

Until some new methods are intro- duced which to date are not even in sight, it will always be much more costly to make color receivers, and at present they cost up to three times as much as monochrome.

MINIATURE SETS

The growing popularity of the "per- sonal" or miniature TV set is only one example of a demand which pre- supposes the simplest and cheapest re- ceiving apparatus possible.

It is not conceivable that all this equipment will be rendered useless at one stroke. On the other hand it throws extra emphasis on the import- ance of compatability which will allow the choice of the same programs in either medium.

Much could depend on possible future developments that could cheapen and simplify color, such as the inven- tion of a display tube simpler than those favored at present, or even some- thing which would display pictures without a tube at all.

But even so, it seems most prob- able that any such radical develop- ment would also have the effect of making monochrome receivers com- paratively easier and less costly to make, indicating that such speculation at present is rather an idle mental exercise.

My own view, therefore, is that although the advantages of good color are undeniable, it may follow the pat- tern of the movies, and be reserved for de-luxe receivers and that section of the community which appreciates and demands the difference, just as in the field of sound there are plenty of hi-fi enthusiasts.

I certainly do not consider the threatened future of color is any jus- tification for delaying the introduction of monochrome TV in Australia, which will face it when it is good and ready.

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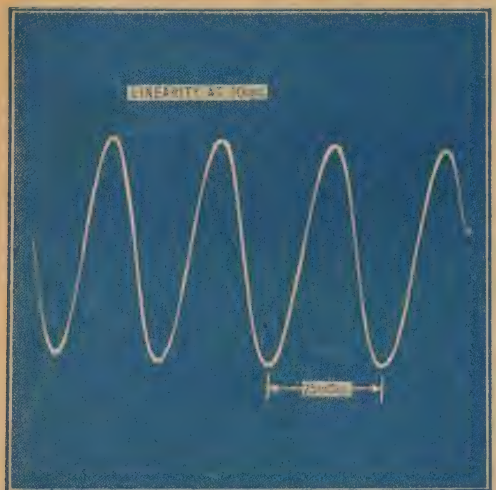


Figure 1: A 40 cps signal fed into the vertical amplifier shows the overall linearity of the new timebase when operating at 10 cps. The load resistance across the output is 2.0 meg. Departure from linearity is barely discernible but could be reduced by increasing coupling capacitors or load.

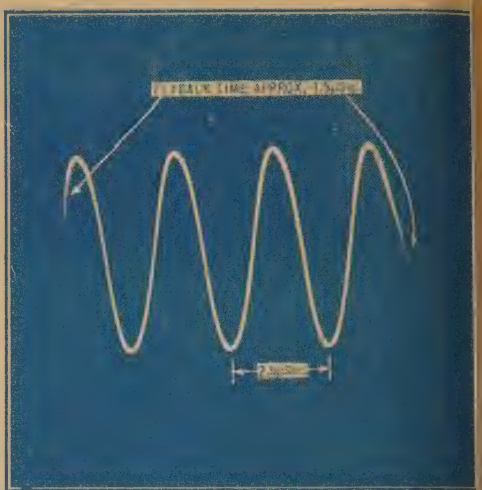


Figure 2: The short flyback time at high frequencies is shown by this oscillogram where the input signal is at 400 Kc and timebase at 100 Kc. The new circuit synchronises perfectly at these frequencies and the linearity is extremely good.

HIGH QUALITY CRO TIME BASE

The development of our future television test oscilloscope is carried a step further with the description of a timebase using high vacuum valves. The performance of the new timebase is very much better than anything we have yet described and the output voltage generated is sufficient for direct application to the horizontal deflector plates of the cathode ray tube. At the same time it is, in fact, simpler than the conventional combination of gas triode and horizontal amplifiers.

ALL of the oscilloscopes described in Radio, TV and Hobbies up to the present time have used gas triodes to generate the linear sweep voltage. Since the voltage output is insufficient to deflect the electron beam across the full width of the screen of even the most sensitive cathode ray tubes, an amplifier is required.

Push-pull deflection systems are often necessary, in order to avoid certain types of distortion which are inherent in a single-ended system. This makes the minimum valve complement for a quality oscilloscope using a gas-triode sweep generator up to three.

THE GAS TRIODE

It is true that the best gas triode time bases are capable of quite acceptable performance. With careful design including, say, a constant current generator (another valve) and attention to the characteristics of the amplifier, the linearity and range of the time-base can be made good enough for most test purposes.

The argument in favor of the new hard-valve time-base is not only that it can do a better job than the gas triode but it can do the job with simple circuits, using compact and readily available components.

Before becoming too involved in the details of either system a brief review of the fundamentals leading up to the generation of sawtooth waves will assist the reader to get the subject into focus.

Practically all linear time-bases, including the hard-valve type described here, make use of the fundamental exponential curve. This curve is met over and over again in relation to natural phenomena but, in this case, we are interested in the voltage which appears across a capacitor when it is charged through a resistor from a constant voltage source.

Considering the circuit of Figure 3a,

by Maurice Findlay

the switch is normally closed and a current of E/R amps flows in the circuit. The capacitor is shorted and therefore the voltage across it is zero. At the instant of opening the switch, the current remains at E/R since there is no voltage across the capacitor.

A small time later some charge accumulates on the capacitor and therefore it develops a potential difference between its plates such as to oppose the supply voltage E. The current flowing is then reduced and with it the rate of increase of voltage across the capacitor.

STUDY OF CURVE

As the voltage on the capacitor increases, the rate of increase decreases until, after a long time, the voltage across the capacitor is practically constant.

The formula relating capacitor voltage and time is given in Figure 3b. In passing it is interesting to note that E only equals E after a very long time. If, in fact, t approaches infinity, t/RC approaches zero and epsilon to the power minus t/RC approaches infinity

voltage across the capacitor then
aches E.
e complete curve is of little use for
oscope time-bases since the rate of
ge of voltage with respect to time
from a large value, when the
is closed, to a small value after
g time. We require the rate of
ge of voltage with respect to time
constant.
approach to the desired waveshape
e made by substituting a gas tube
he switch. When the tube is non-
icting (see Figure 4a) the voltage
s the capacitor rises following the
ential curve as before, until it
es the breakdown voltage of the
As soon as the gas is ionised, the
ance of the tube becomes very low
he capacitor is discharged, because
e heavy current flowing through the

LE OF OSCILLATION

ere is a minimum voltage required
aintain the discharge and, when
capacitor voltage falls below this
, the electrons and positive ions
ine and the gas returns to a stable
The capacitor will now re-
e from the supply voltage through
d the cycle is repeated.
vided the supply voltage, the
down voltage of the gas and the
tion voltage are proportioned so
nly a small portion of the curve
d the sweep can be made linear
h for many purposes.
important point to note is that
utput voltage of the gas tube can
e a small proportion of the supply
e, if linearity is important.
n tubes are occasionally used as
th oscillators for oscilloscopes but
ifficult to arrange a circuit to give
linearity and make provision for
ronising the oscillator with ex-
signals.
tain gas triodes, of which the 884
EN31 are examples, are capable
uite good performances when
ted under suitable conditions.
limitations become apparent as
requency is increased, when the
aken for the gas to change from
nised to the deionised condition
appreciable part of the time for
ward stroke.

T DUE TO FLYBACK

ending on the gas used in the
ular tube, the upper frequency
ceptable results may be from 10
50 Kc.
ther disadvantage of the gas tube
tendency for the breakdown volt-
f the gas to vary slightly from
to cycle in a random fashion
gives rise to a "jitter" of the pat-
when the tube is used to gener-
n oscilloscope timebase voltage.
ffect on the pattern is something
iat of poor focus.
frequency limitations and the
icy to jitter are reasons why the
iode time base rarely appears in
erformance oscilloscopes designed
ercially.
re is a whole series of time base
ements using high vacuum valves
ur interest at the moment war-
only mention of the multivibrator
e Miller integrator arrangements.
multivibrator is used in a num-

DIAGRAMS EXPLAIN TIMEBASE

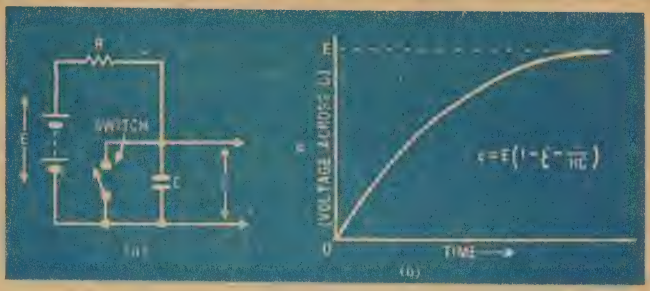


Figure 3: The exponential curve which describes the rate of increase of voltage across a capacitor which is charged through a resistor from a constant voltage source.

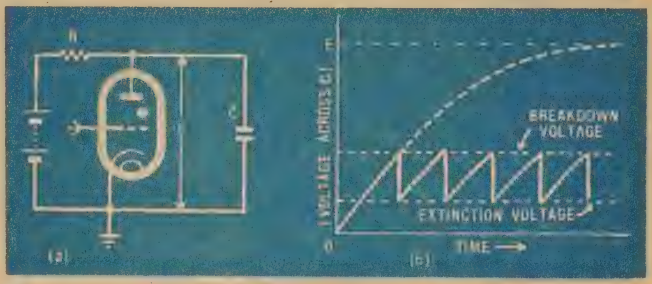


Figure 4: The circuit of a gas triode sawtooth oscillator. Here the switch of Figure 3 is replaced by a valve. Good linearity is possible only if the breakdown and extinction voltages are close together and the supply voltage high.

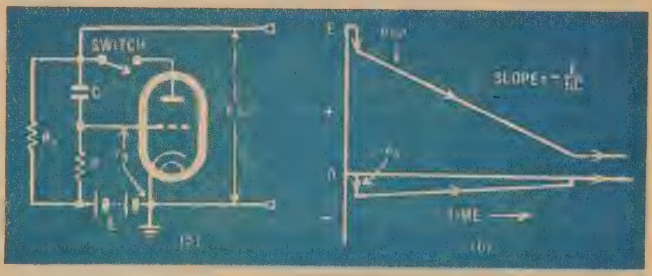


Figure 5: The basic Miller feedback circuit. In practice the initial downward voltage jump is quite small with high gm valves.

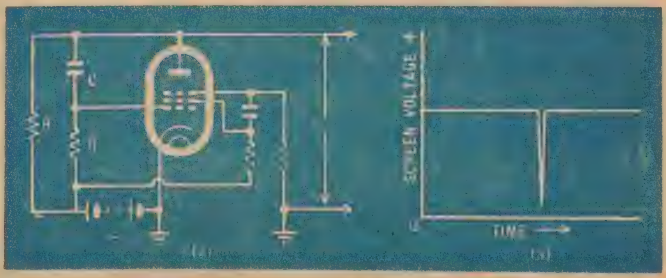
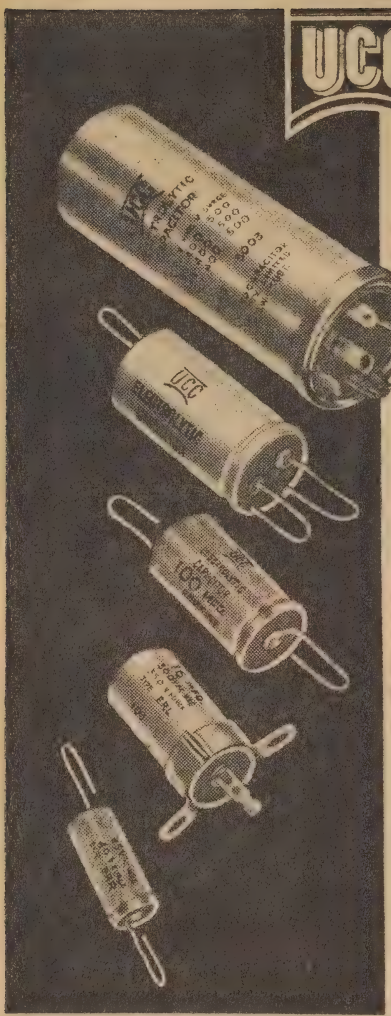


Figure 6: The suppressor grid coupled to the screen through a small capacitor cuts off the plate current during the flyback period.



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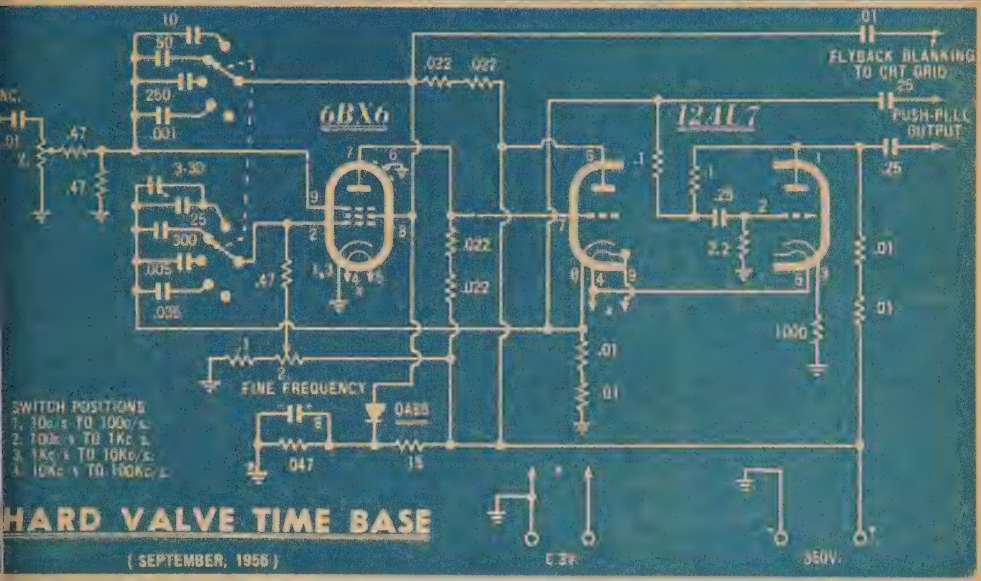
THE NEW TIMEBASE FEEDS DIRECT TO CRT PLATES



gure 7: Although the circuitry may be unfamiliar, there is nothing difficult about the new timebase. From the left the 6BX6 is e Miller/transitron oscillator, the 1st 12AU7 triode section is a cathode follower and the 2nd triode section a phase reversing amplifier with a gain of 1.

of excellent commercial oscilloscopes ently available and is capable of d linearity, good high frequency ormance and easy synchronisation freedom from jitter. In order to eve good linearity, the output voltg can only be part of the supply age and therefore this circuit does normally give sufficient output to ed directly to the deflector plates he cathode-ray tube.

TSTANDING LINEARITY

he Miller sawtooth generator is ble of even better linearity than multivibrator and is capable of taining this linearity, while deving a peak to peak output voltage st equal to the supply voltage. pared with the time bases prely mentioned the overall perance is truly outstanding. One on of the same general arrangement in fact, generally known as the ntastron".

ie name "Miller Integrator", initally, comes from the fact that the it exploits the famed Miller effect, henomenon described by J. M. r in a National Bureau of dards paper published in 1918.

ie sawtooth generator circuit was l developed during World War It found application in radar sysn but it is only since the war that e Miller time base in various forms s found its way into commercial oscilloscopes. Further, it is only e past few years that the circuit s become generally known.

hile a fair amount of information xtbook style is available, there is ically nothing to assist people who wish to build a Miller timebase into their own oscilloscope and who cannot spare the time to arrive at optimum circuit values &c. The circuit published here is the result of many hours' experimental work in the laboratory. Few readers could spare the time to carry out a similar development program.

The performance of the timebase is far better than anything we had tried previously and we are more than satisfied that any reader who builds it into his instrument according to the circuit will not have cause for complaint. At the same time we can see possibilities of further development.

The operation of the complete Miller integrator/transitron of Figure 7 is not easy to understand if you are not already familiar with this type of circuitry. It is best to break the circuit down into single operations and deal with each in turn.

Figure 5a is the basic circuit which generates the linear change in voltage with respect to time and a qualitative understanding of its behavior is not difficult.

Consider the conditions when the switch is open. Current from the supply E flows through the resistor R through the equivalent diode formed by the grid and cathode of the amplifier valve. The forward resistance of the diode is small and therefore the grid is almost at ground potential.

The capacitor C therefore has its lower plate at ground potential and the upper plate connected to the positive supply through R1 so that, with the switch open it is charged to the potential E. The output potential of the system (e out) is therefore almost equal to E.

DETAILS EXPLAINED

At the instant of closing the switch, the valve draws plate current and the potential at the plate drops but since the plate is connected to the grid through C the grid potential also drops and therefore tends to oppose the flow of plate current. The result is a small downward jump of both output and grid voltages.

The grid thus becomes negative with respect to earth but the capacitor C, which is holding it in this position, will attempt to discharge through the series circuit formed by R and R1.

The amplifying action of the valve now makes itself evident.

Any decrease in the charge on C

TIMEBASE DATA

Frequency coverage: 10 cps to 100,000 cps in 4 ranges. Output Voltage (with particular constants given in Figure 7): 140 volts peak-to peak approx, from each output terminal. DC measurements made with 1000 opv meter and timebase operating at 1000 cps. All voltages with respect to earth.

High tension supply 350 volts, 27 mA. 6BX6: Plate 5.3 mA, .044 meg screen resistor 4.5 mA

OA85: Cathode 150V.

12AU7 1st section: Cathode 130V

12AU7 2nd section: Cathode 6.7V.

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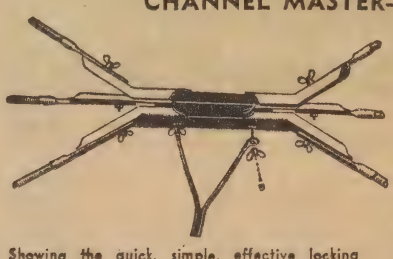

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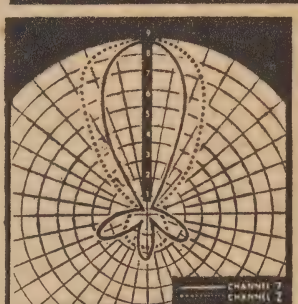
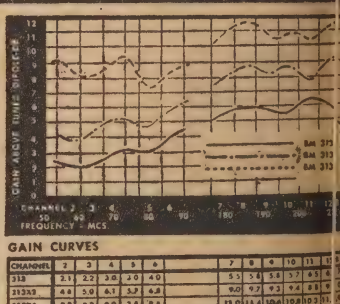


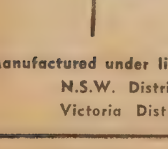
HORIZONTAL POLAR DIAGRAMS



GAIN CURVES

CHANNEL	2	3	4	5	6		7	8	9	10	11	12
313	2.1	2.2	3.0	3.0	4.0		5.5	5.6	5.8	5.7	6.5	6
313X3	4.6	5.0	6.1	5.7	6.8		9.0	9.7	9.2	9.4	8.8	9
313X4	9.0	8.2	9.0	7.5	8.5		11.0	11.4	10.6	10.8	10.0	11.

GAIN IN DB ABOVE TUNED DIPOLE



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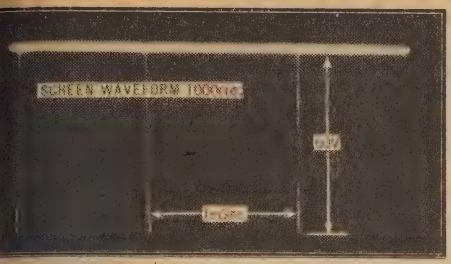
OUTPUT AND FLYBACK SUPPRESSION WAVEFORMS



ure 8: Output waveform at 1000 cps is virtually perfect, slight "tail" appearing in the pattern is due to the imperfections of the CRO used for the photograph.

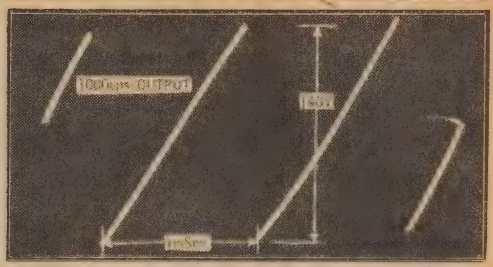


Figure 9: Output from the flyback suppression terminal at 1000 cps. This is normally applied to the CRT 1st grid through a small capacitor. The flyback time is extremely short compared with the time for the forward stroke.

s the grid voltage to become less ive, so that the plate current tends crease. But this also causes the ge drop across R1 to increase, thus ing the plate voltage. By reason of the negative-going tendency at the is coupled to grid and opposes the 's attempt to revert to near-ground tial.

e process continues, with the in- e in plate current being opposed by oltage drop across the plate load or coupled to the grid circuit. ously, the plate current must in- e but, because of the gain of the , it goes much more slowly than uld otherwise.

NOT AMPLIFY

ntually the plate voltage is so low the valve is no longer able to fy. The grid voltage quickly reverts ro and the plate voltage remains constant low value.

u will probably have gathered ively that because of the gain of alve the plate voltage fall tends to ear and, in fact, provided the gain e valve is high, the output voltage all linearly with respect to time, ope being equal to minus E/RC.

is difficult to say more than this ut resort to mathematical sym- n. We will not attempt to repro- any one of the standard proofs but it is worth observing that it sible to obtain expressions for the taneous output voltage of the n at a given time and the linearity ms of the values of R, C and the of the valve.

S OF CHANGE

e the problem involves rates of e it is not possible to deal with it ctorily other than by means of the us. Readers who are interested in g further will find a fairly straight- d expression for the output volt- f the system set out as a solution ifferential equation in Kerkhof and r (see references).

our purposes, the important con- is of an analysis of the circuit at the plate voltage follows an ential discharge curve (the polarity reverse to the polarity of the two s discussed earlier) where the nt value of the capacitor is equal ultiplied by the gain of the valve e apparent voltage from which the tor is discharged is equal to the supply voltage multiplied by the gain of the valve.

If, for the sake of an example, the gain of the valve is 100, the high tension supply 350 volts and the capacitor .01 mfd, then the virtual supply voltage will be 35 kilovolts and the virtual capacitance 1 mfd. Since we may only use, say 1/200th of the total exponential curve it is obvious that the linearity of the output must be very much better than that of the simple gas triode circuit discussed earlier.

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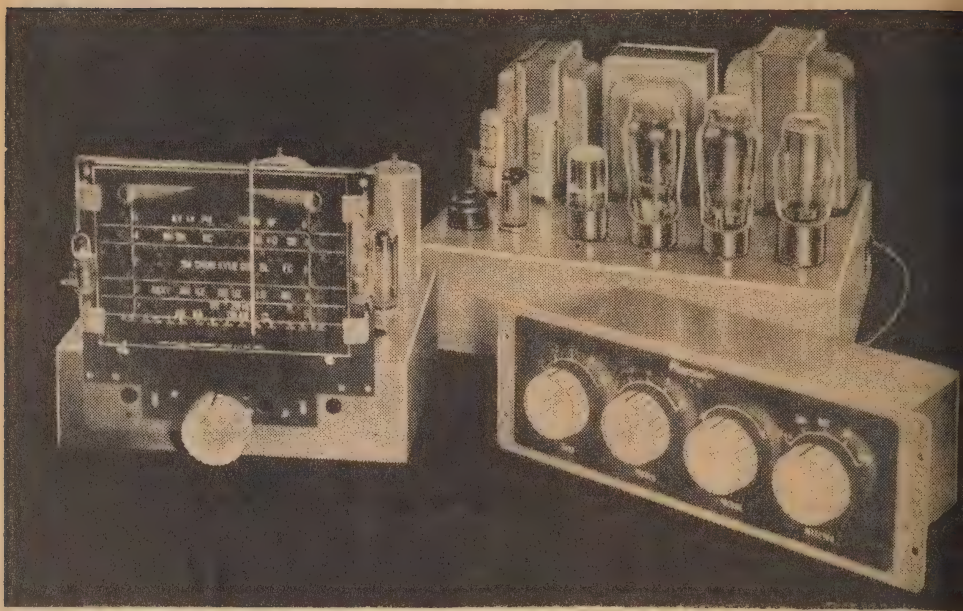

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can these values be measured. It mply that the slope of the curve is same as if these voltages were ent, because of the amplifying action he valve.

o the present we have discussed the r run down of voltage which pro- s the forward trace. Such a circuit ld be useful for the observation of recurrent phenomena where the start ne trace could be initiated by a valve nged to behave as a switch.

When observing repetitive phenomena, s usually the case with radio and vision testing, it is desirable to have forward sweep of the trace start the conclusion of the previous one as little delay as possible. There- the switch should be arranged to k the plate circuit as soon as the ard sweep is complete.

GINAL STATE

ne capacitor C will then charge ugh R1 and the circuit return to its nal condition until the switch is d again. Since the amplifying action ne valve is not concerned in the re- ge of the capacitor, it recharges in nall time compared with the time for the linear forward sweep.

practice there is no switch in the circuit of the sweep generator valve for very obvious reasons it would nconvenient to place a valve switch ne same position. The same action, ever, can be achieved by making use he transitron action which can be to take place in a pentode valve. ferring to Figure 6, when the plate ge of the valve falls to a low value ne end of the forward stroke, the n current increases and, because of dropping resistor in the screen cir- the screen voltage drops.

ie suppressor is connected to the n by means of a small capacitor therefore it goes instantaneously tive b the same amount as the n voltage drops. The result is that plate current of the valve is com- ly cut off.

pacitor C then charges through R1 the return circuit formed by the valent diode action of the control cathode combination. As C is ging, the negative voltage on the capacitor between screen and sup- or leaks away through the return or to ground.

ie result is that a point is reached the plate is able to conduct and ntire cycle begins again.

UPLING CAPACITOR

e coupling capacitor between screen suppressor must not be too small wise it will have discharged to the where plate current begins to flow e C has had time to charge fully he amplitude of the linear forward e will be reduced.

the other hand if it is too large e taken for it to discharge through eturn resistor to earth is longer than e be and the plate current remains ff after the main capacitor C has ed the fully charged state.

effect, too large a capacitor here uses the flyback time and therefore es the maximum frequency at the timebase can operate with the k time only a small proportion of rward stroke time.

hough synchronising pulses can be d to other parts of the circuit, the essor grid is a very convenient If the natural frequency of the Miller integrator/transitron combination is set slightly lower than the frequency of the observed phenomena, it can be brought exactly into step by applying a small fraction of the signal to the suppressor grid. The positive-going portion of the applied signal will cause the suppressor grid to rise and hence the plate current flow to start slightly earlier than normally.

When the oscilloscope has a push-pull output stage, the timebase can easily be synchronised with either the positive-going or negative-going parts of the signal as required. This is important in television testing, where the incoming signal may be far from symmetrical.

The foregoing should be sufficient to give an understanding of the basis of the new timebase. If you have not encountered this type of circuit before it may take a second reading to firmly fix the several ideas on which the circuit depends in the mind.

It now remains to consider how these basic ideas can be converted into a practical timebase.

The Miller/transitron oscillator circuit is not particularly critical of valve characteristics and, in general, any high gm pentode will operate successfully. Types which come to mind immediately are the 6AC, EF50, 6AM6, 6CB6 and 6BX6. The last has separate connections brought out to the base for the suppressor and internal shield which is helpful in keeping the stray capacitances associated with the suppressor circuit to a minimum and hence the flyback time small.

There is not a great deal to it and although we have not actually wired them into circuit, we are reasonably sure that any one of the valves mentioned would give similar results to the 6BX6 without change in values.

For optimum performance the values of the main frequency determining capacitor (C in earlier diagrams) and the flyback capacitor are both switched for each of the four ranges. Fine frequency adjustments are made by means of a 2.0 meg potentiometer.

With the constants shown the range for each switch position is about 15:1. The coverage can be decreased to about 10:1 if required by increasing the present 0.1 meg resistor in series with the 2.0 meg pot with the advantage that the scale will be expanded.

A divider rather than a straight series arrangement is used so that the required frequency coverage can be obtained without using a pot with an excessively high value. Standard units do not appear to give any trouble despite the high voltage gradient.

The stability of the oscillator is such that it is perfectly practicable to calibrate it in terms of frequency. The characteristics of the potentiometer determine the law of the scale and therefore the best procedure appears to be to adjust the frequency determining capacitors so that each range is exactly 10 times the preceding one when a single fine frequency scale can be engraved on the panel and the switch ranges used as a multiplier.

A certain amount of selection will be required to make the ranges fall exactly into place. We suggest that the .035 mfd be made up of stock .02, .01 and .005 units in parallel. A stock .005 unit may prove a little too high for the next range but you may be able to

(Continued on Page 115)

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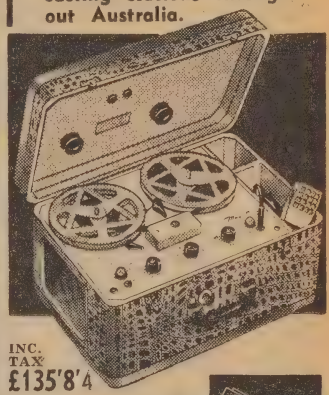

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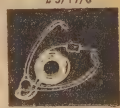

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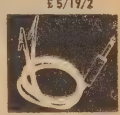

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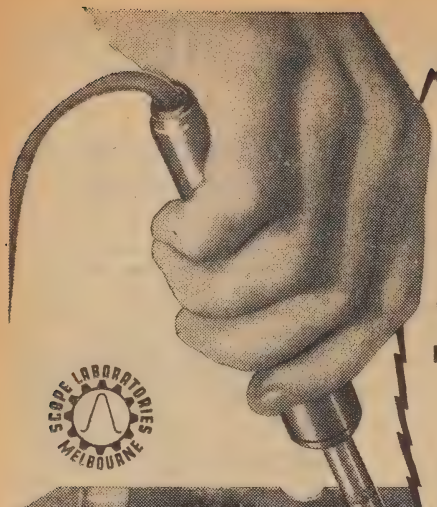

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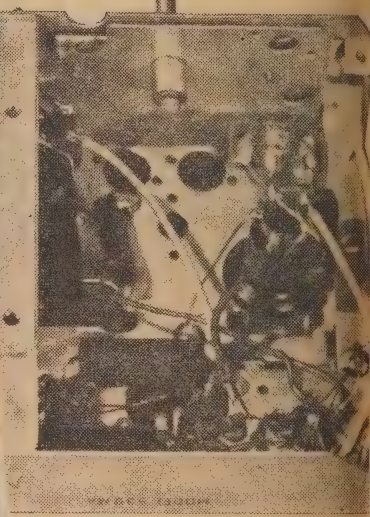

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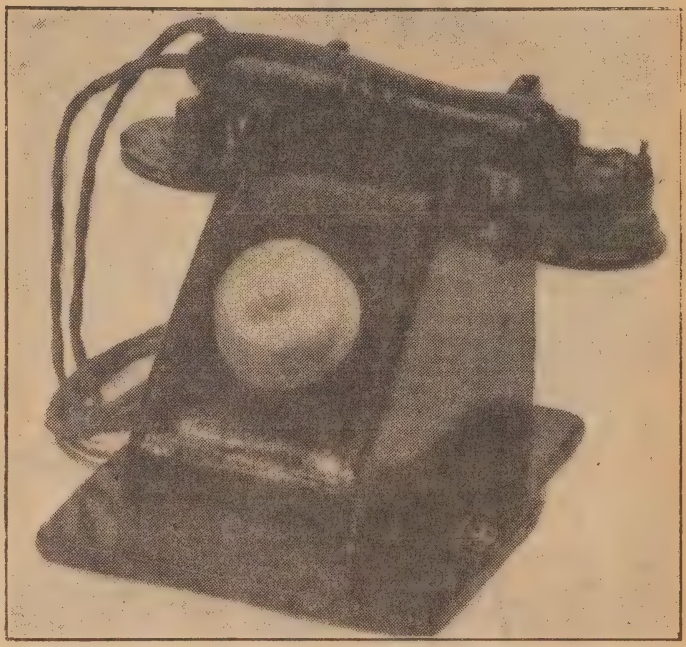
BUILD YOURSELF A TELEPHONE

Here is an article directed particularly at our younger readers—fellows still at school who have been bitten by the "radio" bug or his electrical equivalent and who are seeking a simple first project which won't strain the budget too severely.



The finished telephone ready to take its place in your den. A simple file or chisel handle serves to combine the transmitter and receiver into a complete handset. Note the switch hook lever under the receiver on the right.

/EN in this day and age the tele- phone is an intriguing device, if because of its simplicity. For the ay of a few shillings each and a hours interesting work, a couple of ws pooling their resources can pro- something from which they will ve lasting enjoyment — plus a useful rience in matters electrical.

he writer can speak from practical rience because, years ago, the w next door and I embarked on a lar project. We were both still at iary school and, at that age, the le thing assumed the proportions of ajor engineering feat.

all started when we discovered that ordinary headphone would work in se, making a moderately efficient ophone. Preliminary tests with short s from room to room indicated that ir of headphones would work quite as a complete phone, one unit is used as a transmitter and one as eiver.

iis much proved, we toyed with the of running the system between our ctive houses. Theoretically there it seem to be much to stop us, but ad practical problems to overcome. one thing, although my friends e was "next door", there was a xt block of land bettween us; a r which increased the amount of required to an embarrassing h.

KE

Either of us were particularly flush cially and we realised that, if the vas to be done, it would have to be with what we had, or could unge".

e therefore set about collecting odd length of wire we could find. s a motley collection but, in the , it consisted of scraps of bell wire several pieces of stranded bare r wire left over from the elaborate systems of those days.

e were disappointed to discover that ad nowhere near enough, and the ne looked like being doomed before rted. Then one of us came up what we both regarded as a brilli- solution. Why not unravel the ed wire and join the seperate is together?

A few brief calculations confirmed this would save the day; it only ned to unravel the wire. I imagine e with less enthusiasm than a e of schoolboys would have sought sier way out but, for us, it was all of the game.

We stretched the lengths of wire between a couple of handy fence posts and rolled up the single strand of wire as we unravelled it. Finally we had enough.

Then came our next problem. The distance involved was too long for single span and we decided that a post, with a regular cross arm, would be needed on each fence. A few scraps of timber provided the posts and arms, but we were stumped for insulators.

(To be quite honest, we weren't quite sure why these were needed, if at all but we thought we had better make the thing look right. As it happened, the high impedance of the system really did call for reasonable insulation, as we subsequently discovered.)

We solved the problem in an unconventional but perfectly satisfactory manner. We simply salvaged four small white jars which had once contained a well known vegetable extract and pushed them onto the ends of the cross arms. The groove formed by the patent thread proved ideal for holding the wire in place.

Thus we achieved our line between the buildings. We used the scraps of bell wire to provide the small amount of internal wiring and simply terminated each end of the line in a pair of headphones. When all was ready my friend hurried into his own place while I waited with an ear piece glued to one ear. I heard the rattle of the headphones as he picked them up, there was a moments pause, then his voice; clear, if not particularly loud.

A GREAT KICK

I'll wager Alexander Graham Bell and his assistant experienced no greater thrill than we did that day. The fact that it had all been done before, many times, meant nothing to us. As far as we were concerned it was all fresh ground. Maybe we hadn't invented the telephone, but we had certainly invented a telephone — and the effect was much the same.

After our initial enthusiasm had died down we realised that we still lacked a calling system and that this seriously limited the usefulness of the device. We eventually worked out wiring and switching to correct this, "scrounged" a couple of electric bells, and put together a workable telephone.

My main point in telling this story is to try to convey something of the

by Philip Watson

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PRICE'S RADIO 5-6 ANGEL PLACE, SYDNE

atisfaction which one can experience om a simple project of this kind. he ideal set-up is where two fellows ith similar interests live side by side in such a manner that wires can asily be run from one house to the her.

In such circumstances a telephone as more than a novelty value; it can ecome a really useful device.

To make the whole thing more at- active, there is no need for the school- oy of today to battle in the manner escribed by the writer. With a de- riptive article as a guide and an dequate supply of telephone bits and eces available cheaply through dis- osals the whole thing becomes relatively ain sailing.

The overall result is that, for a lot ss effort, one can make a good deal etter job—something that looks like d works like a real telephone. The nished article is easy to use, efficient operation, and attractive to look at. you'd like to make something like read on.

ETTER RESULTS

On the purely technical side you can pect very much better results from is telephone than are possible with e simple set-up using a couple of pairs headphones.

Far better results are obtained using conventional PMG type transmitter nsert" or carbon microphone and a w impedance earphone. Both these rts are readily available through dis- osals and cost only about 5/- each.

The use of proper switches and press ttons will also provide more reliable rformance than did the pieces of ck spring and similar materials which rmed the basis of my early experi- nts.

So, provided reasonable care is taken ring your units, there should be no ubt about their performance. This ing so, it is worthwhile giving a little ought to the physical form which ey are to take. We considered this oblem at some length and finally de- led that something along the lines the modern PMG handset would offer number of advantages.

ONVENIENT

A handset is convenient to use, com- red with, say, a wall type instru- nt. It can sit on the nearest table shelf. Finally, it can be made to ok reasonably attractive without a eat deal of effort.

Since it would involve a lot of work exactly duplicate a standard hand- s we settled for something rather mpler, though along the same general es. You can see the result in the otograph and we have also prepared a drawing showing the essential mensions and general shape.

If you are not too well versed in the a of cabinet making we suggest you nd the article elsewhere in this issue scribing how to make the Little eneral cabinet.

We finished our unit with glossy ack lacquer, but there is no reason hy you shouldn't use some other color if you prefer. After all, colored tele- hones are the latest thing!

However, this style of case did com- plete the matter of a switch-hook. We considered several ideas, mostly ased on the use of contacts salvaged om relays or lever switches, but finally decided against them on the score that not everyone can get hold of such items. We finally evolved a unit using a standard switch movement, which is quite simple to construct.

It takes the form of a lever which protrudes from the side of the stand and which is capable of moving about 1 5/8in at its tip. The weight of the receiver on the handset is sufficient to depress this when it is "hung up". The other end of the lever is fastened to the switch shaft, which is thus rotated by the up and down movement of the lever.

The switch is a two-pole, two-position wafer type, fitted with a spring return. It is made by MSP, is a standard item, and is known as a series 20, type 22, spring return.

The lever is a piece of ¼in diameter brass rod 4 5/8in long. One end has a flat filed on it and a corresponding flat is filed on the switch shaft. (This latter should be cut down to about ¼in. long). The idea is to bolt the two pieces of rod together, flat face to flat face, the lever being at right angles to the switch shaft. A 1/8in hole is drilled through each and a 1/8in nut and bolt used to hold the two together.

When filing the flat on the switch shaft some thought is necessary to ensure that the lever will occupy the correct position when the switch is mounted. Assuming the switch is vertical, the lever should be 30 degrees above the horizontal under the action of the spring. It should be approximately horizontal when depressed by the weight of the handset.

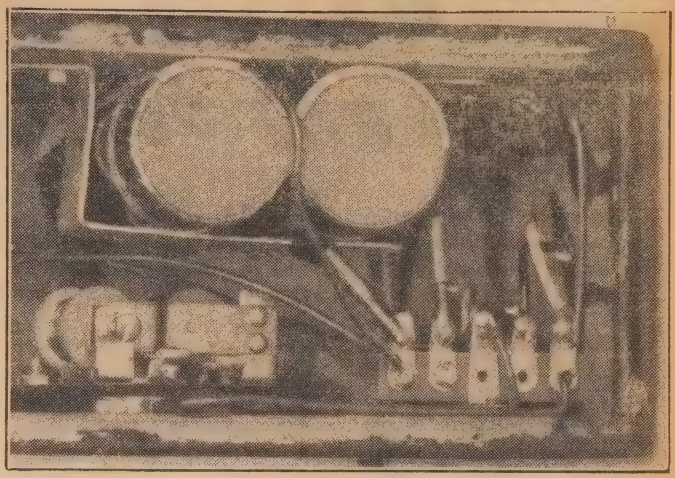
RESTRICTED MOVEMENT

In fact, it is not essential that the full 30 degrees of the switch movement be adhered to. The complete switch action can be obtained with something less than this, which is helpful in limiting the movement of the lever.

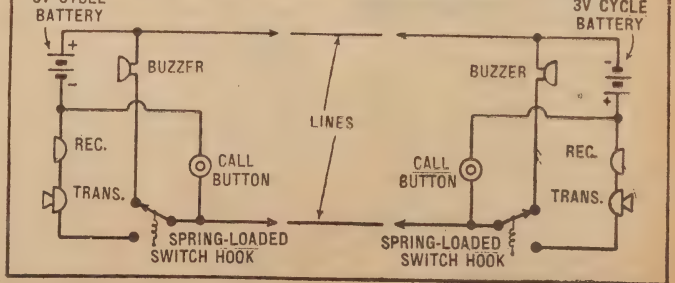
It will probably be necessary always to hang the handset the same way, i.e., with the receiver resting on the lever. However, the movement can be made a good deal more sensitive by "pre-load-

(Continued on Page 113)

UNDERNEATH VIEW OF TELEPHONE



This picture shows clearly the disposition of components inside the stand. The battery is at the top of the picture and the buzzer directly beneath it. To the right is a tag strip used to terminate the line and handset wires. The switch lever and part of the switch is just visible behind the tag strip.



The circuit of the complete system. Simplicity is the keynote and no one is likely to run into strife. Only point to watch is the relative polarity of both batteries. Switches are shown in the ringing position.

Here's your answer, Tom!

Once again, in his quest for knowledge, Tom has forwarded a number of questions. He must indeed be a very busy fellow, for a professional quiz-master would have to tax his imagination to the utmost to present such a variety. However, that is the purpose of these columns, and we have selected a few that have a general interest.

THE first question is a real "evergreen" but, then, there are always newcomers to the hobby who face up to it for the first time.

I am building a two-valve amplifier. According to the circuit the primary of the transformer should be 5000 ohms. I purchased what is supposed to be the correct output transformer yet, when I measured it with an ohmmeter, the reading was about 500 ohms. Is this right or have I been taken down?

You can rest assured that you have not been "taken down", Tom, for, you see, the DC resistance of the primary on your transformer, as read by an ohmmeter, has no connection with the value of load specified.

The output transformer is only a coupling device, Tom, and does not in itself form a load. The loudspeaker is the real load. Ordinary dynamic loudspeakers, however, have a very low impedance and it is necessary to step this up to the value specified for the output valve.

An output transformer does this by virtue of the step-up ratio of the turns

"You haven't been taken down..."

used on the primary and secondary windings. This ratio, in turn, is related to the ratio of the speaker impedance to the load impedance.

The primary is generally wound with many turns of fine wire—hence the resistance as indicated by an ohmmeter.

The secondary has relatively few turns of heavy gauge wire and reads as a low resistance.

Resistance readings are therefore useful to differentiate between primary and secondary but they do not indicate the ratio of turns nor the load which the transformer reflects when connected to a specific loudspeaker.

On a number of occasions, I have seen the terms "Voltage Amplifier" and "Power Amplifier", used when referring to audio systems. What is the difference and what is their relationship to one another?

Both, Tom, are used in the amplification of sound, which has been converted into electrical impulses by a microphone, or generated by a pickup from a record.

A voltage amplifier is designed expressly to deliver a high signal voltage in its output circuit from the weaker impulses that are fed into it. The output voltage is usually applied to drive the grid of a following valve.

A power amplifier is designed to amplify this signal and provide sufficient power in its output to drive a sound reproducing unit. The valve and its operating conditions are chosen to deliver the maximum power into the reproducer, as distinct from maximum voltage.

In very simple audio amplifiers, just a single power stage is sometimes used, in which case a very large signal input is required to drive it. Certain makes of crystal pickups are capable of supplying this signal.

If the original signal is very weak, a number of voltage amplifying stages may be needed to make it sufficiently strong to drive a power stage.

In high quality amplifier systems it is often necessary to introduce correction to the original signal, in the form of bass and treble cut or boost. As a certain amount of loss is introduced by this correction, the number of voltage amplifier stages may have to be increased still further.

Do double gang variable condensers have any advantage over a single gang?

Let's use the word "capacitor" instead of condenser, Tom, as a more modern and a more appropriate word.

The number of gangs, or more correctly the number of ganged sections, in a variable capacitor is decided by the number of circuits you wish to tune.

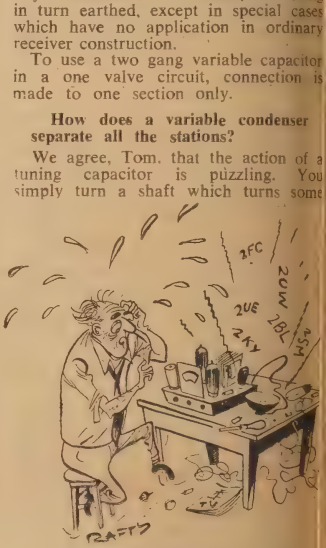
In a crystal set or one valve receiver, for example, there is one tuned circuit and no advantage would be gained by the use of a two gang capacitor. However, if you have one on hand, Tom, by all means go ahead and use it.

In a ganged variable capacitor, each section is independent of the other, having a common connection through the rotor only. The rotor is automatically connected to the frame, this being in turn earthed, except in special cases which have no application in ordinary receiver construction.

To use a two gang variable capacitor in a one valve circuit, connection is made to one section only.

How does a variable condenser separate all the stations?

We agree, Tom, that the action of a tuning capacitor is puzzling. You simply turn a shaft which turns some



"A puzzling business . . .!"

metal plates and the stations appear and disappear in a most uncanny fashion. Whether we can explain it in a few sentences is a moot point.

The important property is the capacitance between the fixed and moving plates and this is altered as the spindle is rotated. The varying capacitance in conjunction with the inductance of the coils, is responsible for the discrimination between stations.

Capacitors and inductors may be connected in series, to form a series-tuned circuit, or in parallel to form a parallel tuned circuit. The latter is the more commonly used arrangement in radio receivers.

You see, Tom, both capacitors and inductors (or coils as they are often called) have reactance. This reactance is the opposition they offer to the flow of alternating current through them.

Reactance varies with frequency. In the case of a capacitor, the reactance decreases with an increase of frequency and vice versa. Exactly the reverse is true of inductive reactance.

If the value of either the capacitance or the inductance is varied, the capacitive and inductive reactance must vary

). Inductance normally remains fixed the capacitance is made variable. As the capacitance is varied (or as circuit is tuned) numerous combina- s will be achieved where, at differ- frequencies, the capacitive reactance st be equal to the inductive reactance. When the two reactances are equal any given frequency, a state of "reso- ce" is achieved. At resonance a allel-tuned circuit offers maximum edance to the frequency at which s resonant, but it offers a very low edance to all other frequencies.

The high impedance that is presented the resonant frequency may be re- ded as a resistance, across which ximum voltage is built up. This age is fed to the grid of a valve, be amplified.

While offering a high impedance at resonant frequency, a parallel-tuned uit acts as a shunt to all other fre- ncies. By varying the capacitor, we nge the resonant frequency and efore select the frequency which is e passed on and amplified. By this ns, a variable capacitor is able to ct some stations and reject others.

Why is copper not used in the aking of variable condensers?

Well, Tom, copper is not very suit- e for the construction of variable densers purely for mechanical and mical reasons. The frame and es of a variable condenser must be y rigid, to prevent them from warp- or being bent out of shape. Copper ery soft.

What is more important, it is also ject to corrosion and verdigris due humidity effects. This is very un- rable in the plates of a variable denser, as its growth would even- ly produce a leakage path between n.

rass is preferred to copper, be- se it is tougher, and less subject to rosion. Lacquered brass or even l- r-plated brass produces a very good lity component.

luminium is not particularly tough, t it is cheap, readily workable and r liable to troublesome corrosion. It sed a great deal in capacitors for rnary receivers and transmitters.

If the AC applied to the plates a rectifier comes out as DC, why it necessary to filter it?

C, as it emerges from the rectifier. ut, is not a pure DC. To underst d the reason for this, you must be b to picture the action of a rectifier. he function of a rectifier is to pass ent in one direction only. In a ll-wave rectifier circuit, the plates are nected to each end of the power sformer secondary, so that each la becomes alternatively negative and ive with respect to the secondary re tap.

hile one rectifier is positive and ducts, the other is negative and pletely ineffective. After one half le, the action reverses, and the second la becomes positive and conducts. ther words, the negative half cycles resuppressed and the current avail- bl at the cathode is actually pulsating he rate of two pulses for every cycle, or at 100 pulses a second.

As a pure Direct Current is required for the plates and screens of the receiver or amplifier, this pulsating current must be filtered or smoothed.

Capacitor input filters are the most commonly used, and are made up from a first filter capacitor, followed by a choke and a second filter capacitor.

The basic function of the filter capacitors is to store energy, when peak pulsations are applied, and to discharge between peaks, thereby maintaining a constant output voltage.

The choke accomplishes the same effect by virtue of the impedance it offers to any changes of current that flow through it. It tends to keep a smooth current flowing.

What is AVC? And how does it work?

AVC, Tom, is the abbreviation for Automatic Volume Control. This, as the name implies, is an arrangement whereby the sensitivity of a receiver is automatically adjusted by the strength of the signal received. This is highly desirable in order to keep the volume from all stations, except the very weak and distant ones, at the same level.

To accomplish this, a portion of the rectified carrier output from the second detector, is filtered and applied to the RF and IF amplifier valves, in the form of extra negative bias.

This negative bias increases and decreases in unison with the strength of incoming signals, thereby increasing or decreasing the amplification of the valves to be controlled. Thus the difference between strong and weak incoming signals is automatically balanced out.

What are metal rectifiers, and what are they used for?

"Metal rectifiers", Tom, is the name given to rectifiers in which the rectifying action takes place between surfaces of two dissimilar metals.

There are two groups which are normally used in radio and electronic equipment, the copper-oxide and the selenium rectifier.

In the copper-oxide rectifier the rectifying action takes place between discs of copper-oxide and pure copper. Conduction between the copper and the oxide depends on the sense of the applied voltage. An important point is that no disintegration of the material is essential to the rectifying process, and the life is virtually unlimited, provided the rectifiers are not allowed to overheat.

The same general remarks may apply to the selenium rectifier, except that its internal resistance is generally less than that of the copper-oxide rectifier. In this type of rectifier the rectifying action takes place between selenium-coated electrodes and iron.

Metal rectifiers have a variety of applications and, of course, come in a variety of sizes and operating ratings. The most common applications for metal rectifiers, Tom, are in the multimeters and battery chargers. The former is generally rated at approximately 5 ma and the latter may have a rating of several amps.

Metal rectifiers are not normally used in radio receivers in this country. The valve rectifier is relatively cheap and plentiful and their life is sufficiently extended to make them a more attractive proposition.

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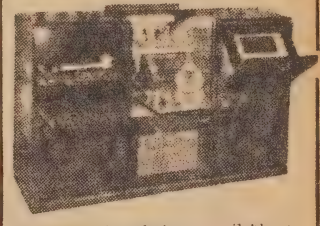

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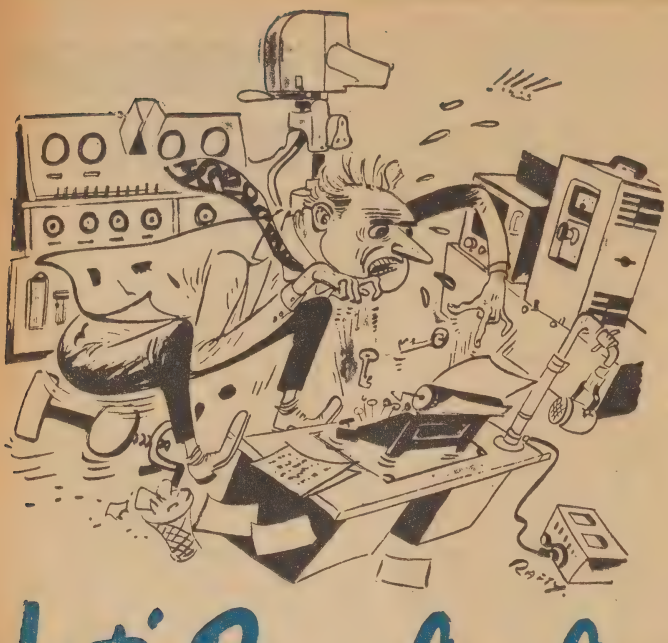


Let's Buy An Argument

During the month I received a letter which, by its opening lines, caused me to tremble visibly. But, as I read on, the trembling gave place to mirth; the look of ashen-faced fear was replaced by a Dagwood-like grin of anticipation.

by Neville Williams

So that you'll be in the picture from the very start, I suggest that you read the letter opposite. Apart from the omission of a few sentences for the sake of brevity, it's just as it came to hand.

Read it? Good!

Now wipe your eyes!

They'll be watering from poring over the maths, or by reason of the touching little piece at the end.

Our friend E.L. is the very personification of kindness. What a dreadful weakness to have. Never suffered from it myself!

OCCUPATIONAL HAZARD

But, as I said at the beginning, the first few lines of the letter brought on the terrible fear that every Editor (or Technical Editor) has lurking at the back of his mind. It's an ingrained inhibition, even worse than a guilty conscience.

It's the fear that makes him grab for a circuit diagram, after he's already passed it three times as OK; the fear that some vital connection shall be missing or a decimal be in the wrong place; the fear of sponsoring a "Little General" with a huge power transformer, just because the draughtsman slipped in an extra 0 between the "50" and the "mA".

Anyhow, after suffering mortal anguish of this sort, at the beginning of E.L.'s letter, I reached the part that mattered—the part where he entered into awesome alliance with George Simon Ohm.

But, as I read on, I experienced a feeling of unreality akin to what I used to feel during English periods at high school.

Once a week, the master used to walk in and, tapping his diaphragm, pose to us the intriguing riddle "Why is a mouse when it spins?"

After a suitably protracted period, he would proffer the answer, "Because the higher the fewer!" Then he'd laugh uproariously.

I never did discover what he laughed at. Us? or some hidden humor in the riddle that has so far eluded me.

By the same token I didn't get very far with E.L.'s calculations — I mean where the figures came from and his references to losses. But it really doesn't matter, because his basic idea and contention is clear enough.

He is simply maintaining that if you put in a power transformer with a higher current rating, then a lower resistance will be necessary in the filter to produce the same voltage drop.

Oh no, E.L.

To reintroduce the earlier reference to bags of cement, etc., you would presumably suggest that a man who picks up cement in a five-ton truck shouldn't just take away one bag.

He should take lots of bags and dump the ones he doesn't want later!

No, E.L., you have the male bovine quadruped by its bony protuberances!

RECTIFIER CURVES

To put things right, let's have a look at a set of curves which takes most of the guesswork out of power supply problems.

They happen to be for a 6X5-GT rectifier, which is electrically very similar to the 6X4 specified in the New Modulated Oscillator. (They're old curves, so we don't mind mutilating them, you see.)

If you look at these curves you find that they indicate the DC volts to be expected at the input to the filter system for different RMS input voltages and for varying orders of load current. The solid lines are for a capacitor input filter and the dashed lines for choke input.

We are interested at the moment in what happens with a 150/0/150 volt input and a capacitive filter, so the relevant curve is the solid black line near the bottom marked "150".

OUTPUT VOLTAGE

Let's see what it tells us:

The minimum load current provided for on the curve is 5 milliamps and we find that, for this load and an RMS input per plate of 150, the DC output to a capacitive filter is 200 volts. We have ringed the reference point on the graph so you can find it easily (Reference A).

But why 200 volts?

Well, the RMS input is 150 volts and this means that the peak voltage on the plates is 1.4 times 150, or 212 volts.

When no load current is being drawn from the power supply, the first filter capacitor charges right up to this peak

lue. In point of fact, it may go a trifle above it because, h no load, the transformer may deliver to the rectifier more n its rated 150 volts.

When a load current is imposed on the supply, the voltage oss the first filter capacitor falls below the no-load peak ue and thus, at the 5 milliamps previously mentioned, the output from the filter is just 200 volts.

Tracing along the 150-volt line tells the rest of the story 10 milliamps load, the output voltage is 192; at 20 milli ps it is 178; at 30 milliamps 167; at 40 milliamps 157 and on.

Maximum permissible load current for the 6X5 is 70 liamps, at which the output has fallen to 134 volts.

Curves like this are available for most receiving type rec rs and are an invaluable aid to power supply design. Of rse, they assume certain values for input capacitor and nsformer winding impedance but the values are generally ly typical of those which one would use with such tifier.

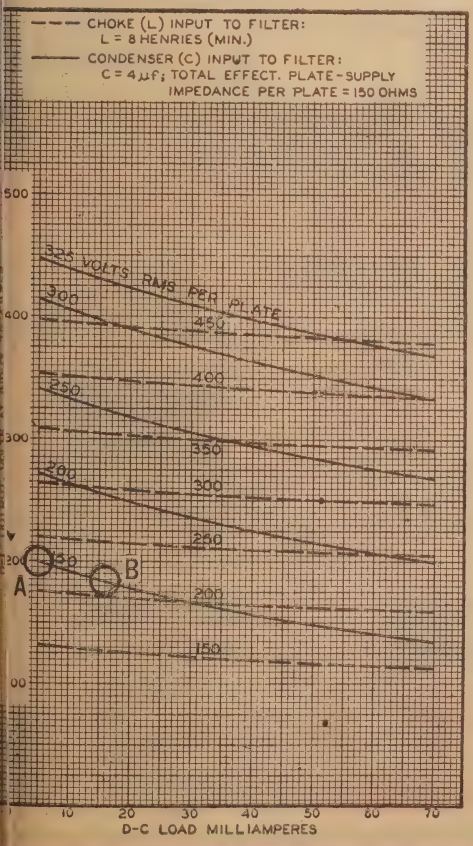
But here's the vital point: The rectified output voltage s dependent on the current which is being drawn from he supply—not the current which any portion of it is apable of delivering.

Well then, how much current would the instrument draw m the power supply?

n point of fact I can't answer this question accurately ause no record of it was kept, as far as I can determine r are valve data of much help because the valves are oper g under non-standard conditions and the actual current depend to an extent on how active is the oscillation.

Working backwards, I would expect the RF oscillator to w just over 2 milliamps, the audio oscillator a trifle more the 6BE6 mixer-output around about 10. A total of abou milliamps therefore looks likely.

Well then, we find on the curve where the 16-milliamp crosses the 150-volt AC line and read off the DC out



A set of curves for the 6X5 rectifier. Quite apart from the argument around such matters, the text explains how such curves are used. They are similar but not identical with curves for the 6X4, which was actually used in the New Modulated Oscillator.

E. L. IS A HAPPY MAN!

Hooray! I am quite happy!

I knew that if I waited long enough, I would get the opportunity to hurl a lovely brickbat at you—one that wouldn't miss!

So here goes:

A friend of mine built the New Modulated Oscillator (Jan. 1954) but could not get a kick out of it. He brought it to me to see whether I could find out what was wrong.

I checked it with the circuit diagram but everything seemed okay. After a few minutes testing, I was not satisfied that the H.T. output from the junction of the 5000 5W resistor, dropping resistor and 8mfd. was high enough, so I worked back toward the power transformer.

I found that the transformer was marked 150/150 40mA. I pointed out to my friend that 150/150 30mA was specified and that this was the reason why he could not get a kick out of it. My friend said that this would not make any difference because you said so in R. T & H for March, 1952. On page 51 you said:

"Readers frequently ask whether a 100mA power transformer can be used in place of an 80mA transformer. Of course it can, provided the voltages are the same. You can carry a bag of cement in a utility but there is no objection to using a five-ton truck, if that is what you happen to have . . . etc".

Oh you've let yourself in the soup quite lovely. It's worth two brickbats! Take the circuit diagram as printed:

150/150 30mA, less 20 pc losses equals 8000 ohms to pin 7.

150/150 40mA, less 20 pc losses equals 6000 ohms to pin 7, making 2000 ohms drop before you come to the 5000-ohm dropper.

You want 100V output; 100V at 40mA is 2500 ohms HT output, yet there is only approximately 1000 ohms HT output.

Now get out of that if you can!

I said "approximately" because my voltmeter is not to hand. I have allowed 20 pc losses but the losses may be more through the tranny and rectifier but the output would be in the same proportion of 30:40mA, viz. 3:4.

Well I took out the 5000 ohm dropping resistor and installed a 3500-ohm dropper and away it went. I had worked out that a 3750 dropper would be about right but 3500 ohms was all I had on hand.

Working out Ohm's Law you will find that, keeping the volts the same, but changing the value of amperage in the power transformer works out thus: As 30 is to 40, so is 3750 to 5000.

I contend that you were wrong in your quotation.

But never mind mate! A man who has never made a mistake has never made anything. I myself make mistakes at times, so possibly I should not throw any brickbats at others but I am only human after all.

Yours faithfully, E.L.

ut. (Reference B.) It turns out to be 183 volts.

Now, according to the article, we want to drop this to 100 volts for the main high tension line—and here we turn o your friend George Simon Ohm.

The voltage drop required is 183 minus 100, equals 83 olts.

The current which we anticipate will flow through the circuit is 16 milliamps.

Therefore the resistance will yield to the formula:

R equals E/I

Changing the formula to accommodate I in terms of milliamps gives us:

R equals 1000 x E/I

The answer turns out to be 5180 ohms, as near as my slide rule will make it.

Actually, the 6X4 delivers a trifle less voltage for the same input than the 6X5 and our suggested figure of 5000 ohms would therefore be very close to

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e mark.
Presumably, things must have work-
out like this, otherwise we would
t have confirmed and published such
value.
Now notice that the current rating of
e transformer hasn't even entered the
cture at this stage. It has simply
en assumed that the transformer will
capable of supplying the required
ad current without overheating.
And the load current has been set at
out 16 milliamps.

MODERATE RATING

On this basis, the transformer need
ve a secondary current rating for
ly 16 milliamps DC output.
In practice, the smallest standard
wer transformer available on the
arket is a 30-milliamp type and this
the type which we specified in our
rts list.
But you see, E.L., the fact that we
ecified a 30-milliamp transformer
esn't mean that the oscillator will
aw any more current. Its basic design
ovides for a 100-volt HT supply and
this 100 volts it will only draw
ound about the specified current.
In point of fact, the oscillator cir-
its, taken together look just like a
00-ohm resistor to the power supply
because they collectively draw about
milliamps at 100 volts.
Putting in a 40-milliamp or even a
0-milliamp transformer would not
ke them draw any more current, so
t the current in the dropping resistor
d the voltage across it would not be
ected to any extent.
In other words, E.L., we suggest that
original statement is strictly correct
d the brickbats you launched should
thwith assume the trajectorial char-
eristics of a boomerang.
One thing we hasten to add: We have
ped scorn on your theory but accept
ur observations and your "practice"
hout reservation.
f the particular instrument required
lower dropping resistor before it
uld operate, then that's that.

L POSSIBILITIES

Perhaps the 12AU7 is weak or has
emission through insufficient heater
tage.
Perhaps the tuning coil or coils
n't the best, thus preventing the
AU7 from oscillating as easily as it
uld.
Perhaps the rectifier has low emission
d is delivering fewer volts to start
h.
Whatever the cause, reducing the
tage dropping resistor has made the
erence and the circuit now operates.
But I can assure you, E.L., that the
io of your new resistor to the old
no bearing whatever on the power
nsformer current ratings.
ust sheer, pure, unadulterated coinci
ice.
io much for E.L. and a subject with
ich I am pretty familiar. But when
comes to regulating watches, H.G.
have all the say.
Mind you, I think he's taken the
stion far too seriously, because, in
t, various horological establishments
undertake to regulate a watch "while
u wait". How well is another matter.
Anyone like a crack at H.G or us?
e, but let's not lose our tempus!

REGULATING WATCH ISN'T EASY

Dear Sir,

It is good to see the picture of an electronic watch testing machine on the front cover of Radio, Television and Hobbies, but the bold statement on page 1 gave me quite a shock.

"Once upon a time", etc., and ". . . to be regulated in a few minutes . . ."

One who is not familiar with watches would believe that careful inspection and patient adjustments, carried out during a number of days or even weeks, are now out of date, and the timer does the same job in a matter of minutes

The secrets of the fine Swiss jewelled lever movement should nowadays be fascinating enough to obtain some publicity in "Radio, Television and Hobbies". May I disclose a few of these secrets?

The oscillations of a balance wheel around its axis furnish a unit of time measurement. The size of this unit is determined by the diameter and weight of the balance wheel, and further by the size and strength of the hairspring.

It usually is 1/5 second, giving 432,000 oscillations a day, for a watch keeping perfect time.

After this brief introduction, let us examine a few factors which could disturb proper time keeping.

(1) VARIATIONS IN TEMPERATURE. These cause a change in both length and strength of the hairspring, and consequently, the duration of each oscillation is no longer 1/5 second.

It is interesting to examine the methods which have been employed to correct this error, but for now, it is sufficient to say that in modern watches, a special alloy is used for the hairspring which has a very low temperature coefficient, and is also anti-magnetic, rustproof, and unaffected by the cleaning fluids watchmakers use these days.

A high quality watch has a temperature error of perhaps one second a day, or less, between summer and winter. In a cheap watch with copper hairspring, this could be five minutes. The electric timer is very helpful in checking thsee errors.

(2) VARIATIONS FROM BALANCE WHEEL BEING OUT OF POISE. (STATIC UNBALANCE). If the centre of gravity is not on the axis of rotation, there will be an error, depending on the position of the watch—winding crown pointing up down, left, or right.

This error could range from one second per twenty four hours, or less, to ten minutes or more, depending on different factors. This is perhaps the most common and annoying error, and the electric timer is very valuable for checking, and absolutely necessary for adjustments closer than fifteen to twenty seconds a day.

(3) ISOCHRONISM. This unusual word means that the duration of the oscillation alters with the number of degrees that the balance rotates.

A change of viscocity of the oils, due to a change in temperature, a change in the output power of the mainspring in the course of twenty four hours running, increase of friction due to wear, thickening of the oil after a period of time, the difference of friction at the balance wheel pivots between positions in which the watch lies flat, face up or down, or hanging, all change the number of degrees the balance wheel rotates.

This is a difficult error to correct, and is largely determined by the hairspring material, and the shape of it. A low error here is what we find in the high quality watch. An electric timer is necessary to determine and adjust this error.

You will understand now that regulating and adjusting a watch to a high standard of performance, for the errors set out above, takes considerably more than a few minutes. even with the help of several electronic instruments such as used at factories.

Here is set out the fine results obtained from a test at a Swiss astronomical observatory. The second column shows the difference during several days testing in the same position.

Performance figures for a wrist-watch

Position of watch.	Rate, seconds per day.	Departure, seconds.
Crown left	+0.92	+0.36
Crown up	+2.07	0.57
Crown down	+0.30	0.55
Dial down	+0.77	0.27
Dial up	−0.15	0.35
4 degrees, dial up	−1.30	0.20
18 degrees, dial up	−0.50	0.10
32 degrees, dial up	−0.10	0.25

In future, you might like to publish some articles on the mnaufacture of modern watches.

Yours sincerely,
H.G.

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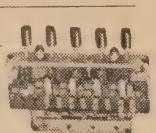

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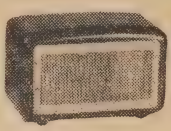

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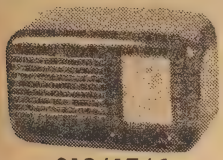

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640 KING STREET, NEWTOWN. PHONE LA6087

FROM THE SERVICEMAN WHO TELLS

Customers are funny people. Leastwise that's how it appears to me at times. A case I encountered this month surely deserves a prize for the ingenious ritual which had been worked out to keep a set playing a particular station when, theoretically, it wasn't capable of playing that station.

HE customer was an elderly lady who entered the shop one morning, fished valves from among the eggs, meat, groceries in her shopping basket, and d me to test them. She explained her set had failed and she thought valves were probably worn out; after the set was 10 years old and it had r had anything done to it.

n fairness to set manufacturers in ral I must comment on the number ets which I encounter which have lar records. Year after year, through he hazards of a typical household, no attention of any kind, they just on going. Surely there are few de- as complex which can even ap- ch this order of reliability. Yet y owners still complain when a seri- call eventually costs them a few nds. However, that is just by the .)

STOMER RIGHT

tested the valves and, for once, the omer's diagnosis was right. The 5Y3 a very sick valve; so sick that I had hesitation in pronouncing it as the e of the set's failure. I reached for w one, then realised that I had none tock. The traveller was due in a hours but right now the cupboard bare.

ot wishing to disappoint the cus- r, and knowing that she lived some nce from the shopping centre, I pro- d to drop the valve in later that noon. She was quite happy with this igement and I secretly suspect that had her doubts about getting all the s back in their right sockets.

nd so, a few hours later, I presented lf at the front door, complete with w 5Y3. The set turned out to be ntel set of well known make and as I suspected, the remaining valves had left for me to instal. Just as well aps. After all, transposed rectifier output valves can cause a lot of r.

OK?

Iplugged the valves in and switched The set came to life as things warm- and I tuned across the dial just to sure that all was well. Everything in fact, appear to be OK and I was t to take my leave when the cus- r dropped a minor bombshell, par- rly as it appeared to be something afterthought.

"ill I be able to get 2GB now?" she l, almost diffidently I thought, as if might be asking too much. I replied she could most certainly get 2GB, with all the other stations. To the point I switched the set on and tuned to the station in ques- n. Immediately the set warmed up, ation was audible.

But I could see that the dear old soul wasn't convinced. Something was puzzling her and she was obviously at a loss to explain the problem. Eventually, after some discreet questioning, I managed to get the story.

It seemed that her two favorite stations were 2UE and 2GB, but of late the only one she could be sure of getting was 2UE. 2GB could be received, but only if the set was tuned to this station before it was switched on. If the set was subsequently tuned to any other station (invariably 2UE) 2GB would be lost and could not be restored.

The old lady went on to explain that it was necessary to switch the set off, allow it to cool, set it to 2GB, then switch on again. I regarded it as something of an understatement when she pointed out that this was sometimes a little inconvenient. I was also rather surprised that an obvious non-technical user had been able to develop this rather complex technique for receiving a particular station. I admit I was also rather puzzled for a few moments as to the cause.

PROBLEM

While it is not unusual to expect that the local oscillator would fail at the lower frequencies as the HT voltage dropped with the ageing rectifier, I was momentarily at a loss to explain how the ritual described could ensure reception of the station. Then a few moments' thought suggested a possible reason.

It was fairly obvious that the local oscillator was dropping out somewhere between 2UE and 2GB, at least under normal running conditions. But during the warm-up period and before the output valve got going properly, the poor decrepit old rectifier was able to whip up a few more volts, if only for a few seconds. And apparently this was sufficient to jolt the local oscillator into action on the lower frequency, assuming it was so adjusted and, furthermore, it would keep working as long as it was undisturbed.

However, once tuned to a higher frequency and then back again, it would drop out between stations. Thereafter, nothing short of a jolt from the warm-up cycle would start it going again.

So there it is. A nice little theory, and a reasonable one I think. Unfortunately it will have to remain just a theory, the valve in question being no longer capable of operating the set at all.

But the really surprising thing was the fact that the set had apparently been deteriorating over a period of several months, the stations vanishing one by one as the rectifier became weaker and weaker. Yet it was only when the set failed completely that the owner sought my aid. Truly, some people will tolerate almost anything in the way of radio performance.

And now for a more typical case of a rather rare fault which puzzled me for quite a few minutes before I finally tracked it down.

The set was an ordinary five-valve chassis with a fairly conventional octal valve line-up, an exception being the detector and first audio stage which was a 6Q7, a rather unusual valve these days. The owner complained of low volume and distortion, and I visualised something quite routine, such as a sick valve or a plate load resistor "gone high".

On the bench I quickly confirmed the owner's story. Performance was woefully poor and a finger on the grid cap of the audio stage produced a weak and anaemic buzz from the speaker; nothing like the healthy blurp one would expect, even allowing for the triode driver stage. I inverted the chassis and reached for the multi-meter. This was going to be easy.

Since there wasn't any screen resistor I first checked the plate load of the 6Q7. This was OK and I followed it up with a check on the bias resistor and the valve itself. These were also OK and I turned my attention to the 6V6.

The main HT voltage was normal, also the bias voltage across the back bias resistor. This seemed to eliminate such possibilities as a weak valve, a leaky coupling capacitor, or a weak rectifier valve. However, just to make sure I tried a new 6V6. Results were identical.

There seemed only about one thing left; an open circuit coupling capacitor, though I couldn't reconcile this idea with the very heavy distortion which was evident. However, it was easy to substitute a new one, which I did. Once again results were no better.

CONTRADICTORY

I'm afraid that stopped me for a few minutes. For the moment I felt that I had tested everything, and yet the fault still persisted. Since such a contradictory state of affairs was obviously ridiculous I had clearly overlooked something.

I went over the circuit mentally, ticking off the things I had checked and seeking those I had overlooked. Two items stood out, the speaker and the speaker transformer. I wasn't interested in the speaker since it was my own bench speaker, but the transformer was part of the set, mounted on the chassis.

I connected an output meter across it and turned up the volume. While not conclusive, I was gratified to notice that it could not be driven appreciably above 10 volts, representing a very low audio output.

Becoming more suspicious I connected the ohmmeter across the speaker primary. I'm not quite sure what I expected but the result rather surprised me. Instead of the usual 350 to 500 ohms one

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ally finds in such a winding, this howed only 100 ohms.
re certain than ever now that I n the track I quickly disconnected ransformer and wired a new one rarily into place. There was no about it this time, the set came to vith a full-throated roar before I get at the volume control.
icked up the discarded transformer urveyed it. Then, remembering the le it had caused me, I heaved it into bbish bin. I didn't need to open it to what the trouble was. Somewhere a goodly section of the primary ng was shorted out, as evidenced by astic reduction in DC resistance.

AT LOAD?

all wonder that it caused weak and ted signals. With the greater por- of the secondary shorted out I n't even hazard a guess as to the presented to the 6V6, to say noth- f the energy being wasted as heat shorted turns.
bably the most unusual aspect of ault was that it involved so much winding. Most internal shorts in- only a few turns at the most; a which makes them virtually impos- to detect with an ohmmeter. How- the results are much the same, nergy wasted in even a few shorted being sufficient to wreck com- y the performance of any output

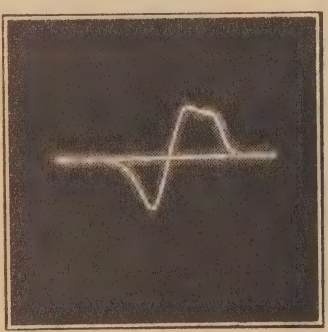
d now for a few more thoughts the future—and television. On the technical side I recently had an tunity to examine and use one of rrently available sweep and marker ators designed expressly for TV nent. A colleague, who deals in devices, was good enough to pass ver to me for a few days with the stion that I ". . . fiddle around with I see how it performs".
it was that I came really face to with one of these electronic mon- for the first time. I gazed at its plicity of knobs, dials, switches, and nals and realised this was the kind ing we would soon have to accept everyday item in our workshop.

KING BACK

ouldn't help recalling the first sig- enerator I encountered; a simple h device by modern standards, yet rsome monster to those accustomed djusting the simple TRF receivers ose days with nothing more than a driver and a keen ear.
ilarly, the first CRO set some of us on our heels momentarily, making nder whether the game was getting ough. But the significant point hink, that we mastered these devices l a great deal more rapidly than we ned possible at the time. Today it d to realise that we ever regarded as a problem.
it reasonable, then, to regard TV he instruments that go with it in ame light? Frankly, I think it is. ttedly, there are bound to be prob- to start with, but determined effort eryone's part should solve most of The worst possible thing we can to allow ourselves to be scared by is, after all, only a relative com- y, and to adopt a "too hard for attitude.
ming back to earth after this little of philosophy, I took another look e instrument, read through the in- struction book, and realised that I lacked one important item to enable me to check it under working conditions, namely, a TV set.
Then I had an idea. A friend who was something of a high fidelity enthusi-

The tuner's response when we first tested it. Note the lack of symmetry and the "bend" on the lower section. This appears to be result of restricted IF band width.

ast had, some years ago, built himself a FM tuner to go with his rather elaborate audio set-up. Unfortunately he had never been completely satisfied with its performance, in spite of repeated attempts to align it using conventional equipment. Eventually it had fallen into discard.
Here, then, was a chance to do my friend a good turn and at least get the feel of the new instrument, even if the job I proposed to do fell somewhat short of that required for a complete TV receiver.
My friend did not need any urging and we brushed the dust off the tuner, got it working, and then set about connecting it to the test gear. I suppose most of us have a general idea of the principles in-



A typical pattern which we produced while adjusting the IF to correct frequency. It is only one of an almost unlimited variety which can be produced by deliberate mistuning. It is mainly due to the discriminator tuning differing from the IF.

volved, but a brief run over them may not be out of place.
Because of the wide band of frequencies which must be handled by the tuned circuit of either a TV or FM set, plus the fairly critical adjustment required for an FM discriminator, it is not possible to employ the simple technique of adjusting all the tuned circuits to peak at a single frequency.
In the case of a TV set the required band-width can only be achieved, along with adequate adjacent channel rejection, by providing a sufficient number of tuned circuits in the IF channel, each adjusted to a slightly different frequency and spread over the band of frequencies involved. By carefully selecting the "Q" of each winding (often involving the use of loading resistors) it is possible, theoretically at any rate, to produce a channel having the required flat top and shaped sides.

TEDIOUS BUSINESS

But, as anyone who has ever fiddled with a wide-range tuner knows, it is a tedious business trying to assess the "shape" of a band-pass characteristic without special equipment.
Using a conventional generator it is necessary to tune back and forth across the band, keeping one eye on the generator and the other on the output meter. If it doesn't appear symmetrical one can only try fiddling with this adjustment or that, repeating the checking process each time, until something like the required effect is obtained. As I said, it's a tedious business and the results may leave much to be desired.
The sweep generator overcomes this in an ingenious manner. As its name implies, it sweeps across the required band, its frequency varying continuously from the lowest to the highest involved. It does this at a frequency of about 50 cps.
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3762	45 volt Portable "B" Battery	4-3/8	2-1/2	5-7/8	18/9 ea.
3765	9 volt Portable "A" Battery	3-1/4	2-11/16	4-1/16	10/3 ea.
3770	45 volt Plug-in "B" Battery	8	4	7-7/16	34/6 ea.
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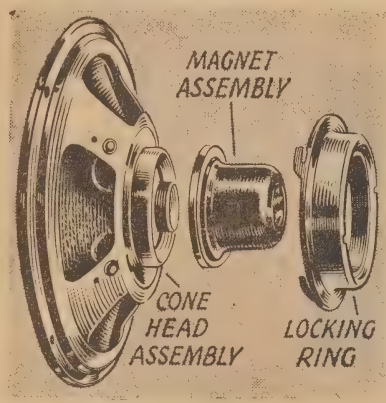

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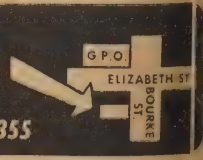

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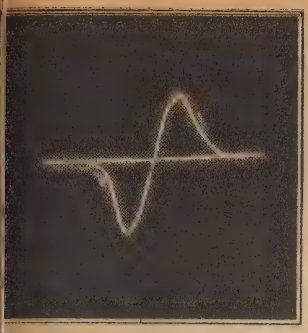
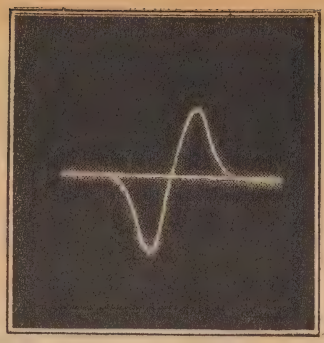


he best we could achieve with sys-
em as it was. Although much improved
he "bend" at the top of the pattern
uggests insufficient IF band width.
he same effect is also present to a
sser degree on the lower portion.



The result we finally achieved after "doctoring" the IF transformers. Although very good there was evidence that the band width was still barely adequate, the lower section still showing some evidence of this.

voltage, the value of which at any
tant is strictly proportional to the
quency, and which is applied to the
izontal deflection plates of a CRO.
us, as the spot is moved across the
een, its position at any moment rep-
ents the frequency of the generator
that moment.

If we now apply the output from
detector of our channel under test
the vertical deflection plates of the
O the height of the spot at any
tant will indicate the response of the
nnel at that particular frequency.
As a result, every time the sweep
erator sweeps across the band, the
O traces a pattern of the response
ve on the screen. Since this occurs
a speed fast enough to deceive the
, the CRO presents a continuous
ge of the response curve and shows
mediately the result of any adjust-
nt.

In addition, modern sweep generators
orporate a separate "marker" gen-
tor. This part of the instrument is
re like a conventional generator and
ply operates at any set frequency.
is normally provided with a crystal
crystals for checking purposes, so
t a high order of accuracy is pos-
le.

ARKER "PIP"

When this marker frequency is mix-
with the sweep frequency it pro-
es a beat frequency every time the
ep generator frequency crosses the
rker generator frequency. The re-
t is a widening of the trace as the
t pattern is super-imposed upon it,
oducing a marker "pip".

Thus the frequency represented by
y point on the trace can be quickly
d easily determined; something which
really essential for correct TV align-
nt.

Other refinements consist of pro-
ion to vary the band over which
generator sweeps (normally from
o to about 15 Mcs), attenuators for
h the sweep and marker generators,
l means to adjust the marker gen-
tor to the crystal standard. These
visions would be regarded as essen-
on all sweep generators for TV
rk. More elaborate instruments will
ubtless boast even more facilities.

don't mind admitting that it took
friend and I some time to familiar-
ise ourselves thoroughly with all this and we produced some funny effects for a start. For one thing, we found that the amount of marker signal injected was fairly critical. It had to be sufficient to provide a visible pip, yet not so much as to cause weird interlocking effects with the sweep generator.

We also discovered that the effect of the marker pip becomes less pronounced as (1) the swept bandwidth is reduced and (2) as the nominal working frequency is reduced.

As far as I can see, the marker pip will always have a certain width, in terms of frequency, for a given detector system, so that it is fairly obvious that it will occupy a much greater proportion of the trace when sweeping, say, 300 Kc for an FM system, than when sweeping 5 or 6 Mcs for a TV system. Assuming that the marker pip occupied 30 Kc in each case it would cover 1/10 of the entire trace in the former case, but something like 1/200 in the latter case.

BEST PATTERN

I need hardly say that the narrower the marker pip the more useful it is, since its meaning is far less ambiguous. On the other hand, even when it is well spread out, it is still possible to observe the point of zero beat, representing the exact marker frequency.

(Just between you and I, I found the marker pip a most fascinating device. I could easily waste a lot of time just watching it run up, down and along

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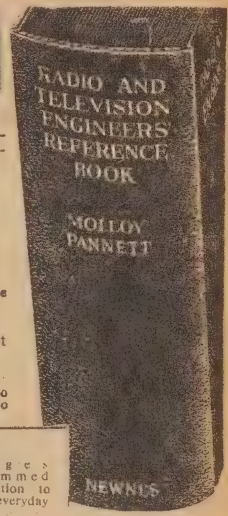

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Address.....

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Your Signature.....
(Or your Parent's if under 21)

Place X where it applies.

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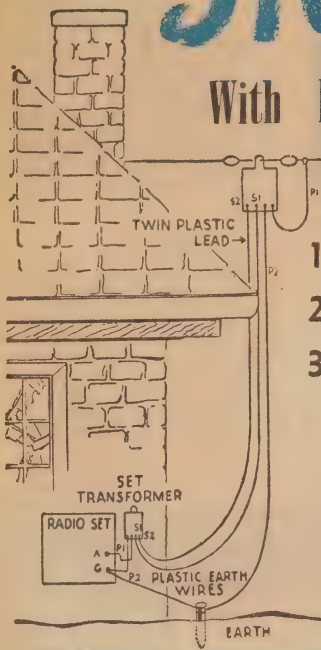
Lodging Address	

STOP NOISE IN YOUR SET

With R.C.S. aerial and line filters

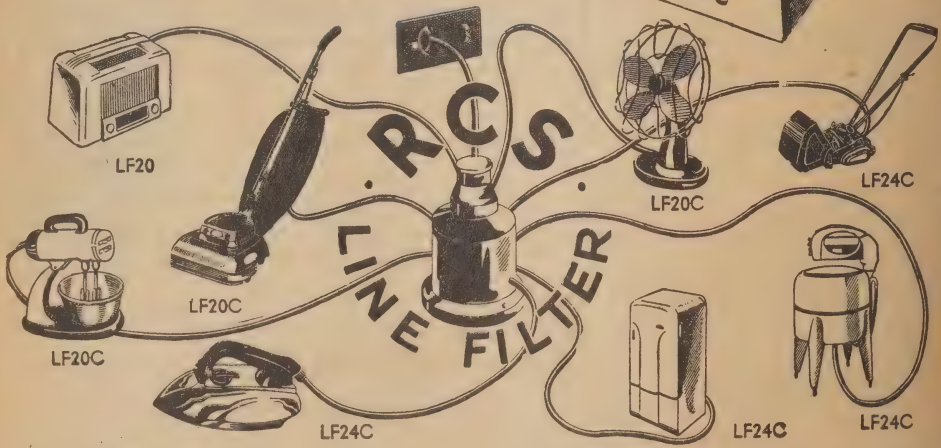


MAKE THIS SIMPLE TEST:—

1. Remove aerial from set. If the noise stops, you need an AF21C aerial filter, as the noise is coming through your aerial.
2. If the noise continues, you need an LF20 line filter as the noise is coming through your power main.
3. If any of the appliances shown below are causing the noise, then fit to it a line filter of the type shown.

AF21C aerial filter
LF20 line filter
LF20C line filter
LF24 line filter
LF24C line filter

CONFINE NOISE WHERE IT STARTS — WITH R.C.S. LINE FILTER



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the trace. But doubtless I'll get over that.)

As I have already suggested, the exact frequency width of the marker pip appears to be a function of the frequency response of the detector system. Thus a detector, whose RF by-pass provided high attenuation at 20 Kc would give a very much lower amplitude pattern at this frequency (and even less above it) than at the very low frequencies approaching zero beat.

I have since discovered that it is considered normal practice to restrict deliberately the frequency response of the oscilloscope vertical amplifier in order to restrict the width of the marker pip. A simple by-pass of suitable value across the input terminals is usually sufficient.

Having satisfied ourselves about these minor points and gained a good deal of useful background into the bargain, we finally produced a pattern on the screen which represented the overall bandpass of the IF channel and the characteristic of the discriminator. The result looked pretty horrible and we had little doubt as to the cause of the unsatisfactory performance.

TRACING DIFFICULT

At this stage I attempted to make a tracing of the pattern for future reference and possible use in these pages. I wasn't doing so well at this when my friend made a suggestion.

"Why not photograph it?" he inquired.

"Think you can?" I countered. I knew he was proud of his photographic prowess — and with justification — but I couldn't resist a sly dig.

"Course I can," he snorted, "a couple of supplementary lenses, some fast film, and about . . . ." and he went off muttering about "f" something or other and similar photographic functions.

In a few minutes he was back with a twin reflex camera, a tripod, some supplementary lenses and the rest of the paraphernalia with which amateur photographers seem to bedeck themselves. While he set things up I darkened the room as much as possible to increase the contrast on the screen, then set the trace to as bright an image as possible consistent with reasonable focus.

My CRO is a five-inch type and my friend was able to get within 18 inches of it. This gave an image about one inch in diameter on the ground glass and my friend assured me that it would enlarge perfectly satisfactorily.

He wasn't too sure about exposure, but settled for two shots at 1-10 and 1-5 second respectively, aperture f3.5, and a medium fast film (125 ASA, according to him). Subsequently, both negatives proved to be quite adequately exposed.

From this point on we photographed most of the interesting patterns we produced and I am asking the Technical Editor to reproduce some of them for readers' benefit.

POOR PATTERN

As I have already stated, the first pattern we obtained was pretty woeful, though we could recognise the basis of a typical FM discriminator pattern. (Fig. 1.) According to the marker pip, the IF channel was not exactly on 10.7 Mc anyway, so the first job appeared to be to correct this fault.

The effect of adjusting the IF transformers took a little getting used to. It was a twofold one, affecting both the shape and overall amplitude of the pattern. Bit by bit I steered it toward the right frequency, keeping the discriminator roughly aligned at the same time. The whole process was purely experimental and I make no claim that I adopted the most desirable method.

Having set the channel on the correct frequency, we turned our attention to the discriminator. The job here is mainly one of adjusting the slug in one half of the secondary to provide an accurate centre tap, at the same time adjusting the primary and secondary trimmers to ensure that both windings remain on frequency.

In fact, this proved quite a simple job and it didn't take us long to obtain a pattern which was a great deal better than the original. However, it was still far from perfect, no amount of adjustment being able to eliminate a pronounced "bend" in the characteristic, near each peak.

After much head scratching we finally decided that it was probably due to insufficient band width in the IF channel; a more-than-likely possibility, since the IF transformers were some of the first ever produced for FM service and even their makers now admit that they have made better ones since.

WIDENING THE RESPONSE

We fiddled around with the loading resistors, reducing them in value consistent with reasonable gain, and this helped considerably. The final result (Fig. 2), while still not ideal, was so much better than the original that we both felt that the experiment was worthwhile.

On the air the tuner sounded very good, at least when we were treated to some decent program material, though my friend's keen ears were apparently still able to detect some distortion on very loud passages. Nevertheless, he was quite happy with the result, insofar as it showed what could be done. He announced his intention of having another go at the tuner, possibly with some new IF's, and then have me check it again.

As I shall probably have my own sweep generator by that time—and have learned to use it—it should not present any problem.

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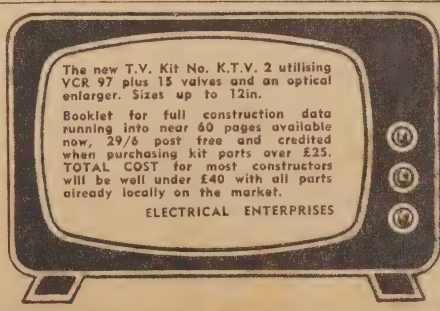
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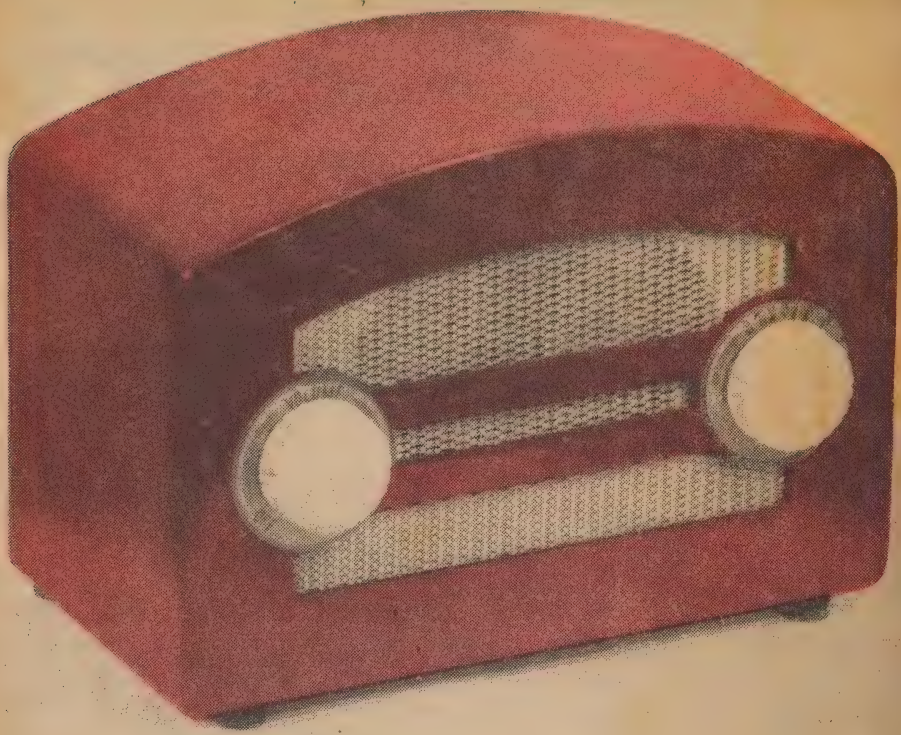


The complete set housed in the cabinet described in this article. Construction is not difficult and most readers should feel confident to tackle it, even as a first attempt. The tuning and volume scales were originally produced for our Mantel Major.

A CABINET FOR YOUR NEW SET

For a change this month we are getting away from the electrical side of things for a while. Our set needs a cabinet, and what better way to provide it than by making it yourself? Even if you have never tackled this kind of work before, there is no reason why you can't make a first class job. So let's give it a go, shall we?

MOST young fellows these days have some woodworking experience and ability, but, if you haven't, this is as good a time and as good a manner in which to acquire it.

In spite of the development of plastics and other materials, wood is still one of our most popular materials. It is reasonably cheap, readily available, and easy to work. The finished product whether painted, polished, or stained can be made truly attractive.

So, if you have hesitated so far to try your hand at a little cabinet-making, why not have a crack at it now? You'll find it easier than you think, the experience will be invaluable and you will find it a relaxing pastime which will prove a pleasant change from your other hobbies.

What is more, you will be able to display your set and say "I made that—the set and the cabinet." Your friends will regard you not only as a genius, but a versatile one as well.

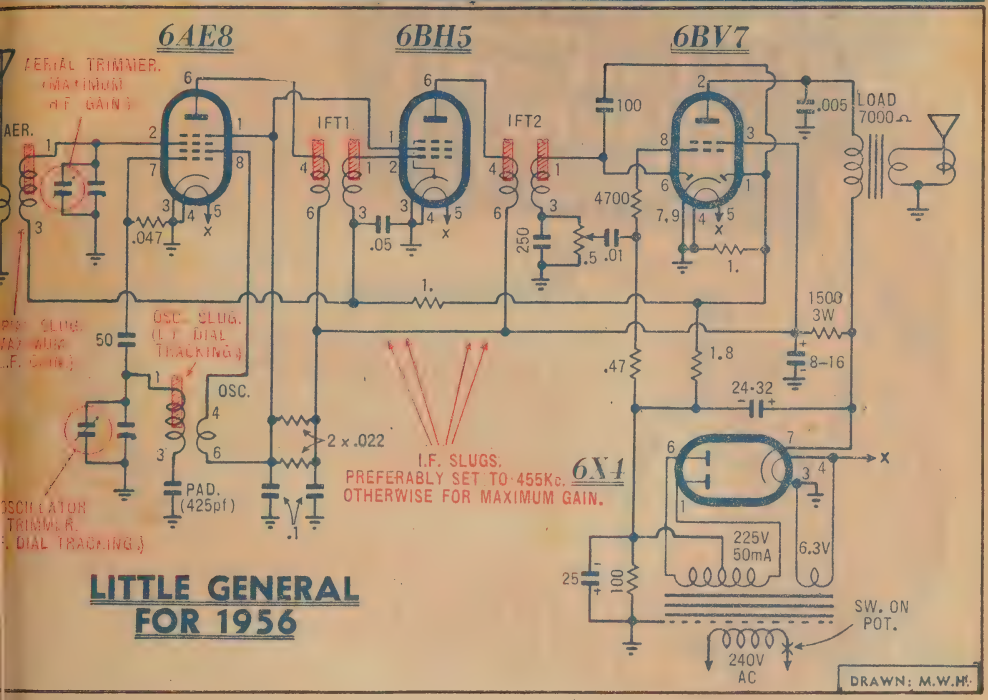
To start at the beginning, let us consider what tools will be required. You will need a hammer, a saw, a plane, a square and rule, a coping saw, a brace or breast drill, assorted twist drills or carpenter's bits, a half-round wood rasp, rat tail files, and such minor items as glass paper, panel pins, glue, etc. The simpler items you may already have, but others, such as the plane, may have to be bought or borrowed.

If you intend to do any amount of woodwork in the future—and this is just the kind of thing to whet your appetite—the purchase of one or two good quality tools will be a sound investment. If you can't afford this just now you will have to try to borrow what you need.

The detailed drawing we have prepared should provide all the dimensions you require, as well as detailing the materials needed. However, some discussion on various constructional points may help the beginner.

The material is 3-16in and 3-8in plywood, the thinner material for the front and top, the other for the sides and bottom. If possible, get resin-bonded ply-

THE COMPLETE CIRCUIT—READY FOR ALIGNMENT



LITTLE GENERAL FOR 1956

ere is a reprint of the circuit with the alignment adjustments overprinted in red. Study this in conjunction with the text and you should have no difficulty in achieving satisfactory alignment, even without the aid of instruments.

in preference to glued plywood. ugh a little dearer, the bonded ply much nicer material with which to , and shows less tendency to splin- hen being cut.

ll sheets of plywood are pretty ex- ve, but it is often possible to buy off-cuts from hardware stores or a 's shop.

NG OUT

ving secured the material, the next s to mark out each piece required paration for cutting. We have pre- a drawing in which the exact size shape of each piece are clearly n. Due allowance has already been for the various overlaps, etc., and nly necessary to duplicate the pieces y as shown.

is worth while taking some care his job, particularly in making sure erything is squared up accurately. our square and double-check be- making any cuts. Also, be sure to sufficient space between adjacent , as laid out, to allow for the of the saw cut—this can be more you might imagine — plus about for each piece.

scribe the curve representing the the cabinet set up a pair of com- to give a 12in radius, then locate ntre on a line passing vertically h the centre front of the cabinet, o placed as to give the correct at the side of the cabinet.

large enough compass is not available a loop of string and a pencil will make a good substitute.

When sawing, do not saw right to the line. Leave something between 1-16 and 1-8in, depending on your skill, for subsequent truing up with the plane. With the exception of the curved top, the front is left oversize until after assembly. In this way it can be dressed exactly flush with the body of the cabinet. Similarly, the top should be cut longer than required, and not dressed to size until assembly is complete.

In planing it is necessary to exercise care to avoid splintering the plywood. Due to the construction of plywood it is almost inevitable that at least one piece of wood will have its grain running at right angles to the line of cut. As a result, taking the plane past the end of the work will almost certainly result in splintering such layers.

USING THE PLANE

This is avoided by the simple expedient of planing from each end toward the centre and it is a good idea to set the work up in such a manner that this can be done without the need continually to reverse the material.

Don't be too greedy with your plane. It is far better to remove a moderate amount of material at a time and exercise a little patience, than to take a lot at one bite and suddenly discover that you have overshot the mark and removed more than was desired.

To accommodate the curved top of the cabinet it is necessary that the top of each side be planed to a suitable angle. This is shown dotted in the drawing of the cabinet front. Mark this angle carefully and scribe lines on each side of the wood to serve as a planing guide. The job is not really difficult and minor inaccuracies will not be serious.

The curved top of the cabinet face is first cut out with a coping saw, working as close to the line as possible with safety, and then dressed to the exact shape using a rasp and some coarse glasspaper. The small back section is treated similarly and, in fact, there is no reason why the two pieces of timber may not be clamped together and cut and dressed as one, if you prefer to tackle it that way.

The actual top needs to be "pre-curved" in order that it will conform readily to the shape required. To attempt to fasten it in place without this preliminary treatment would be asking a great deal of the nails and glue which are to hold it and would probably result in the top lifting at a later date.

BENDING THE TOP

The curving is done by wetting the timber, then forcing it into the shape required, or, better still, an exaggeration of this to allow for some springiness, then leaving it to dry overnight. There are several ways in which the required bend may be retained while drying, such as the use of weights or nailing to a prepared jig.

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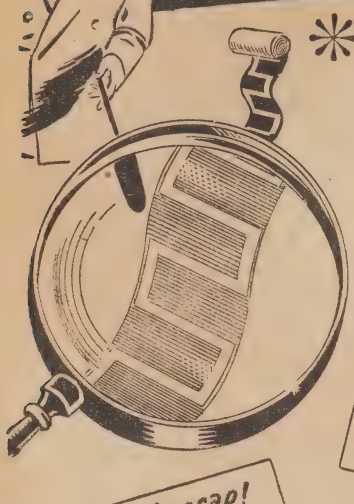

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n2

The scheme we used is explain
the accompanying sketch, which is
tually self-explanatory. Such an arr
ment should not be hard to duplica
most cases.

The amount of wetting is not cr
but soaking in cold water for five
minutes would appear to be quite
factory. Glued ply might need t
treated more carefully in case the
affects the glue.

While the top is drying, the sp
fret may be cut in the front portion
then the remaining pieces assemble
is important to cut the speaker fre
fore assembly, otherwise the depth
cabinet will restrict the movement
coping saw.

SPEAKER FRET

The fret is cut roughly with the
ing-saw, then dressed with the rasp
round file, finishing with glassp
There is, of course, no reason wh
design of the fret should not be mo
if you prefer, remembering that its
purpose is to let the sound out.

When this is done, the assembly
be commenced. The joints are
using panel pins and glue. Two
of glue are available, hide glue
casein or cold water glue. The fo
is very good and customarily use
professional carpenters, but has the
jection that it needs to be heated, p
ably in a special glue pot, before
Casein glue, on the other hand, ca
mixed with cold water and be read
use in a few minutes.

The cabinet should be first assen
by means of the panel pins, using
two pins for each joint, and making
that all edges are flush and true.
joint is then prised apart (leaving
panel pins in the outer piece), glu
plied to the two faces, and the joi
made using the panel pins and hol
a guide to accurate assembly.
applying the glue, avoid obscurin
holes. Additional panel pins may
be used to strengthen the joint.

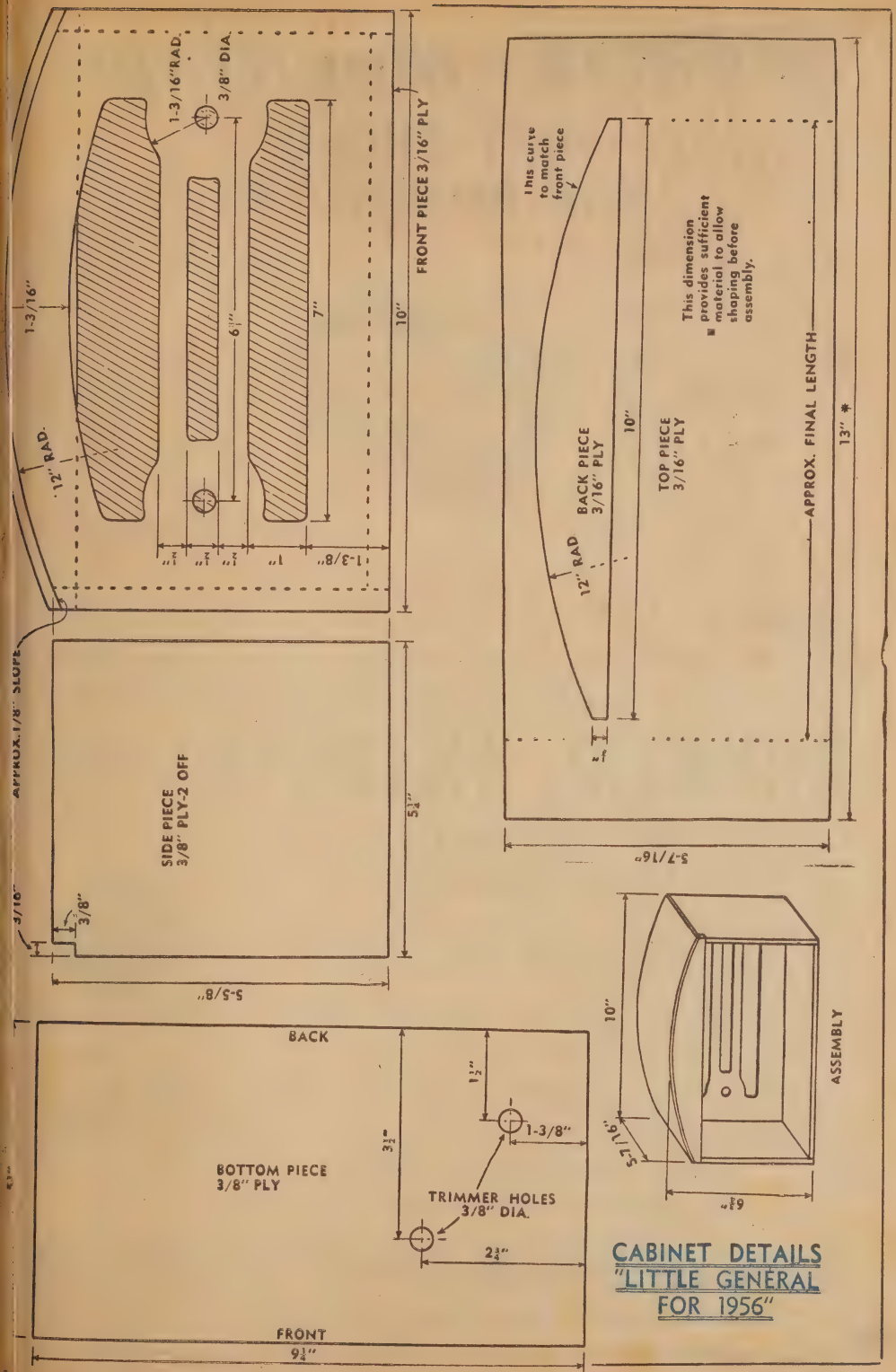
PANEL PINS

For the 3-8in material use 3in
pins, and for 3-16in material us
pins. Take care when driving int
edge of 3-16th material, as when fi
ing the top to the front and back
the pins are driven straight and int
centre of the wood. Otherwise th
a danger of splitting it.

When the whole job is tacked sec
together, surplus glue may be rem
with a damp cloth and the assembl
aside to dry, preferably overnight.
much easier to fasten the top to a
assembly than one which has just
glued.

Before fitting the top, mark a
line across it and also mark centre
on the front and back of the cabine
matching these marks during asse
one is assured of even overlap at
end and a better fit between the
of the top and the curve of the ca

The dimensions of each piece of wo
are shown in this diagram, making
laying out of the job extremely
Note the method of assembly, par
larly location of the bottom
inside the end pieces for ad
strength. The top is cut oversiz
allow for bending and fitting.



CABINET DETAILS "LITTLE GENERAL FOR 1956"

PYROX *Magictape*

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Suppliers of recording equipment say that Pyrox Magictape is automatically first choice when a recorder is needed for reliable operation where no service facilities are available. Pyrox will give you, too, absolute lowest maintenance and long, long hours of trouble-free high fidelity recording.

Controls are simple—one speed for both speech and music, fast forward and rewind, 2 hours high fidelity on each spool of tape.

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ZEPHYR

TO MEET THE AUSTRALIAN USERS' REQUIREMENTS

MODEL 1XA — with Zephyrfil Sintered Filter — Aluminium diaphragm—fully protected crystal.
60-6500cps—45db Grid 1—5 meg load.

MODEL 6XA — with protected aluminium diaphragm — patented crystal unit
70-7000cps—38db Grid 1—5 meg load.

MODEL 11XA — with Zephyrfil Sintered Filter — Aluminium diaphragm —
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ALL UNITS FITTED WITH REAR HUM SHIELDS

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11XA 38/6 ea.

Stocked by leading wholesalers in each State

ZEPHYR PRODUCTS PTY. LTD.

PHONE BL1300

58 HIGH ST., GLEN IRIS, SE6, VIC.

Tack the top to the centre front and
tre back; make sure that it fits flush
ng the front and rear edges, and then
ly glue to the faces to be joined.
rking outward from the centre, tack
ng the front and rear edges and then
ng the top of each side. For the lat-
the longer panel pins may be used
will help to offset any lack of curva-
in the top.
When the glue is thoroughly set the
inet is ready for finishing. This may
several forms, such as staining,
shing, covering or painting. Painting
a number of advantages, particularly
the beginner, and modern lacquers
enamels give a remarkably good fin-
even if one is not especially skilled
he game.

SURFACE

ot the least important factor in de-
ining just how good a finish you
uce is the manner in which the sur-
is prepared. It is more than likely,
natter how carefully you have work-
hat there are one or two minor chips
ome of the corners. Don't be dis-
ened by this — it happens to every-
. The important thing is knowing
to correct it.
ie of the handiest materials for this
is plastic wood, a cellulose-base
tance having a consistency similar to
, but which dries rather faster and
no preparation before applying. It
be purchased in tubes from most
and hardware stores and will keep
od condition for a long time.
l use it is applied to the chip or other
ft and moulded to the general shape
e job. Since it tends to shrink a
l when drying, it is best to make the
ed portion rather larger than the
nder of the work. When thoroughly
y may be sanded to conform with
st of the job.
T: whole surface should now be
d, using a medium grade of glass-
r for a start, and particularly for the
er portions, then finishing with the
grade to produce a really smooth
e.
Nv for the actual painting. Normal
ce is to first apply a coat of grey
coat to fill the pores of the wood
rovide a suitable surface for the
paint. In this way the relatively
undercoat is substituted for one
f the more expensive enamel.
Hever, for a small job of this kind
kely that the smallest quantity of
l you can buy — a quarter-pint
f-pint tin — will be more than
n, anyway, so that it will probably
aper to use, say, three coats of
l than one of undercoat and two
e mel.

ING

any case, the technique will be
the same for both. The first coat
be allowed to dry thoroughly and
nded with fine glasspaper, paying
ular attention to any rough spots.
ld be possible to dress this down
nooth surface, even if the actual
ge is not perfectly even.
second coat will cover a good deal
and may even cover well enough
e a third coat unnecessary. How-
, third coat will be desirable in
ases and there is little point in
g things at this stage.
e it is desirable that the first coat
wed to dry as hard as possible,
paint manufacturers recommend
s unwise to allow the second coat
completely before applying the

PARTS LIST

1 Piece aluminium for chassis 7¾ x 9in x 16g.
1 Piece aluminium for V/C bracket 2¾in. x 1¼ x 16 or 18g.
1 Power transformer 225V 50 mA 6.3V 2A Type PF201 or U50/225.
1 Two gang midget tuning capacitor with planetary drive. Type R.M.G. 2.V.
1 Oval loudspeaker type 4-5C.
1 Speaker transformer type EBG96.
1 6X4 valve.
1 6BV7 valve.
1 6BH5 valve.
1 6AE8 valve.
1 7 pin miniature wafer socket.
3 9 pin miniature wafer sockets.
2 Midget IF transformers Nos. 1 and 2 types J32 J33.
1 Aerial coil type M24.
1 Oscillator coil type M26d.

CAPACITORS

1 30 mfd 350 PV electrolytic.
1 25 mfd 40 PV electrolytic.
1 8 mfd 350 PV electrolytic.
2 .1 mfd 400V paper.
1 .05 mfd 200V paper.
1 .01 mfd 600V paper.
1 .005 mfd 600V paper.
1 425 pf mica (padder 5 pc tolerance)
1 250 pf mica.
1 100 pf mica.
1 50 pf mica.
2 Trimmers.

RESISTORS

1 1.8 meg ½W.
2 1 meg ½W.
1 .5 meg. pot. with single pole switch
1 .47 meg. ½W.
1 .047 meg ½W.
2 .022 meg 1W.
1 4700 ohm ½W.
1 1500 ohm 3W.
1 100 ohm ½W.

MISCELLANEOUS

1 8 tag terminal strip.
2 5 tag terminal strips.
1 4 tag terminal strip.
3 Grommets ⅜in.
1 Grommet ¼in.
2 Knobs type MV9.
2 Terminals with insulating washers.
1 Plywood baffle 8in x 5½in x 3/16in.
1 Piece expanded aluminium 5½in x 8in (Approx).
20g tinned copper wire.
3 Core power flex.
Hookup wire.
3 Pin plug.
Nuts and bolts.

ADDITIONAL PARTS REQUIRED THIS MONTH

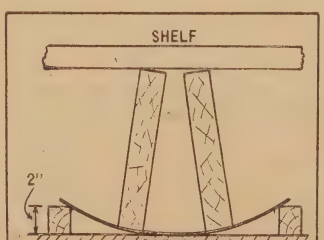
1 set Mantel Major dial scales (Aegis)
1 Roblan pointer suit R.M.G. 2. V. type gang .
1 Csk screw 2½in x ¼in.
Materials for cabinet. See drawing and text.

third coat. By this it is not meant that the second coat should still be tacky; on the contrary, it should be dry enough to handle, but it should not be left for several days to become glass hard. Such a condition apparently does not provide a good bond for the next coat.

Color, of couse, is a matter of personal taste. You may elect to use a pastel shade to tone with the furnishings of a particular room, or you may prefer a bold color to provide a vivid splash by contrast with its surroundings. But whatever you do, try to do it properly. If a color is intended to match, try to match it correctly. If it is to contrast, then don't be afraid to let your head go a little and make it really bright.

We used a glossy red, partly because we had this color on hand, but also because we like the finished effect. Glossy black is another suggestion, and this looks well with the white knobs and, if you can get it, some gold-tinted expanded aluminium. One reader who used such a combination reported that it was most effective.

When the final coat is thoroughly dry we can commence the final stages of our project; the fitting of the set to the cabinet, preparing and fitting the dial scales and, of course, the final alignment.



Details of how to bend the top before fitting. The wood is soaked in water for about 10 minutes and allowed to dry while bent. The bend should be exaggerated to allow for springiness

FITTING THE CHASSIS

The small back portion of the cabinet has been so designed that the baffle can pass underneath it if the chassis is tilted slightly. When the chassis finally slips into place the top of the power transformer should just clear the back.

It may be necessary to trim slightly the top corners of the baffle and aluminium grill material to allow for the shape of the cabinet top. Only a small amount should need to be removed and it is not a difficult operation.

When the chassis is finally fitted and its exact position determined, provision must be made to fasten it in the cabinet The easiest way to do this is by means of a single 2½in screw passing through the bottom of the cabinet and the top of the chassis. A countersunk type, 1-8in diameter, is suitable, and the head is recessed into the underside of the cabinet.

The best position appears to be near the rear edge of the chassis, in line with the gap between the 6BH5 and the second IF. When drilling the hole, check to see that no components are in danger of being damaged.

Scales for the volume and tuning control are those originally designed by Aegis for use with our Mantel Major and are best identified by that name. They take the form of a celluloid disc, 2½in in diameter, to which is at

acos

A COMPLETE RANGE

CRYSTAL MICROPHONES
MICROPHONE INSERTS

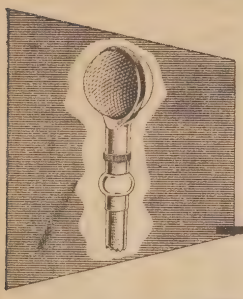
FOR EVERY PURPOSE

DESK or HAND MICROPHONE, MIC36

This Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost. **PRICE, £6/18/6.**

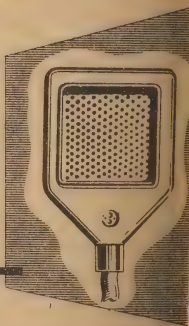
TABLE or STAND MICROPHONE, MIC22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the equation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost. **PRICE. £9/18/6.**



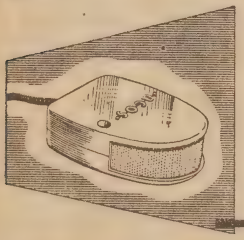
HIGH-QUALITY MICROPHONE, MIC16

This Microphone incorporates the world-famous floating crystal sound cell construction. Its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise. **PRICE, £24/19/6.**



LAPEL MICROPHONE, MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel. **PRICE, £5/19/6.**

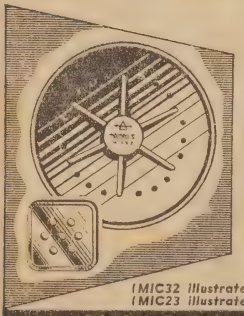


GENERAL PURPOSE, MIC35

The MIC35, is ideal for amateur transmitters, public address, etc Housed in an attractive die-cast case, it features a high sensitivity and substantially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s. **PRICE, £2/15/-.**

HAND or DESK MICROPHONE, MIC33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. **PRICE, £6/18/6.**



CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes, ranging from as small as ⅛ in. square to 1-⅛ in. round, with various thicknesses from 5/32 in. to ⅜ in. Suitable for every purpose, such as hearing aids, public address, tape recording, amateur transmitters, etc., they have responses from 2,250 c.p.s. to 3,500 c.p.s. at -5 db to -30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC19/4 and MIC32, **£2/15/6**; all others, **£1/19/6.**

(MIC32 illustrated)
(MIC23 illustrated)

Sole Australian Agents:

AMPLION (A'sia) PTY. LTD. 88 Parramatta Road Camperdown Sydney, N.S.W. Phone LA 6124

Victorian Distributors: DISTRIBUTORS CORPORATION, 403 Bourke Street, Melbourne.

a suitable transfer. In the case of ning control, transfers are avail- ving scales suited to each State. wise to drill the central hole in luloid discs before mounting the s, thus reducing the risk of dam- placing the transfers under the mporarily, it will be easy to lo- e centre. Make the centre hole than 5-16in.

TRANSFER

soak the transfer in water for 0 minutes, which should be suffi- separate it from its paper back- is reasonably strong, and will moderate amount of handling care is exercised. Slide it from er on to the celluloid, face down, ntre it carefully. If it refuses into the exact position required, replace it rather than try to

correctly positioned, smooth it tly, working from the centre to side, and blot off surplus water cloth or blotter. Preferably, leave ight pressure, as from a book, y. Then cut out the centre hole, sharp knife or razor blade.

inished scales are fastened to the the cabinet with two short ms, one through each of the rcles just out from the centre. It od idea to support the front rom behind while this is being avoid the risk of damage to the k. The tuning scale has a pointer k on the extreme right, and this e set horizontally.

pointer is supplied by the mak- he gang, as a separate item, but uited in its present form for use e Mantel Major scales. It is by clipping off the existing inters and replacing them with a onger pointer. This latter can ort length of 18g tinned copper retched to remove kinks, and to the front of the pointer bush. dimensions have been followed , the rear section of the vernier haft should come far enough the panel to allow the pointer engage it without fouling the dial When the knob is fitted the end ointer will appear above it, mov- educed speed as the set is tuned. d be set to the mark on the scale e gang is fully closed.

brings us to the final step—the nt. If you have followed the in- ns carefully so far, you should e set reasonably well aligned, om correct calibration against the his is the job now to be done. ief resume of the procedure thus not be out of place.

RST

deal arrangement is to have the nel aligned on a signal generator, yourself if you have access to instrument, or by someone else cannot manage it yourself. If not be, it will be necessary to job with the aid of broadcast ignals.

ing that preliminary adjustment rial and oscillator trimmers and s been successful, and that the forming reasonably well, it is in try some careful adjustments to ugs.

is you will need a non-metallic er to engage the slots in the ad- slugs. These are available from io stores or you can make one from a scrap of bakelite or plastic rod or, at a pinch, from a piece of thin wooden dowel. Whatever the material, it is merely a matter of filing a suitable screwdriver point on it.

Tune in a weak steady signal, such as a not-to-distant country station, and set the volume to a minimum. Now try shifting one of the slugs in the second IF, having first noted its position to allow resetting if all does not go according to plan. If improvement in signal strength is observed continue the adjustment until best results are obtained.

Repeat the procedure with the opposite slug, then return to the first one to compensate for any mutual effects between the two, and finish with a second check on the second plug. Repeat this procedure for the first IF, reducing the volume from the speaker by means of the volume control if it becomes appreciably louder due to improved adjustment. This is to allow the ear to detect small changes in volume, to which it is most sensitive at low levels.

FINAL ADJUSTMENT

The set may now be fitted to the cabinet in preparation for the final adjustment. As you will have noted, two holes have been shown on the cabinet drawing, in the bottom of the cabinet, marked as trimmer holes. These are to allow access to the trimmers after the set is fitted and if placed as shown, should be very close to the logical position for the trimmers. If the holes and trimmers do not line up, it will probably be easier to change the trimmer positions slightly to correct this.

The slugs of the aerial and oscillator coils will also have to be adjusted and would normally call for two more holes in the bottom of the cabinet. This can be overcome if we equip ourselves with a very short non-metallic screwdriver, making possible adjustment from the top of the coil.

Make sure that the pointer lines up with the set mark on the scale when the gang is fully closed, then tune in a local station around 600 Kc (such as 2FC, 610 Kc in Sydney) and note whether it tallies with the scale calibration. If not, adjust the oscillator coil slug until it does, determining the correct direction of adjustment by trial and error.

When the calibration is right, adjust the aerial slug to produce maximum sensitivity.

HF ADJUSTMENTS

Now tune in a station at the high frequency end, say 2SM, in Sydney, and check the calibration again. If it is out, use the oscillator trimmer to bring it right, then follow up with adjustment of the aerial trimmer for maximum sensitivity. To offset any interaction between adjustments at opposite ends of the dial the whole process should now be repeated, starting at 2FC, checking the calibration, etc., right through to the adjustment of the aerial trimmer.

And that just about winds up our story—at least for this month. We had hoped to describe how to fit a filter choke, but space and time would not permit. All being well we will cover this next month. In the meantime there is nothing to stop you going right ahead and finishing off the present version You will find it an excellent little set, capable of first-class results—and made all the more enjoyable because you have built it yourself.

So go to it—and good luck!

Edels

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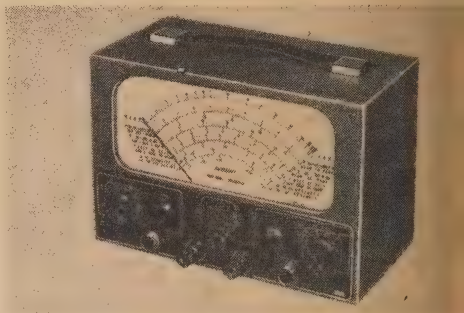
TV TEST INSTRUMENTS

by **UNIVERSITY GRAHAM**

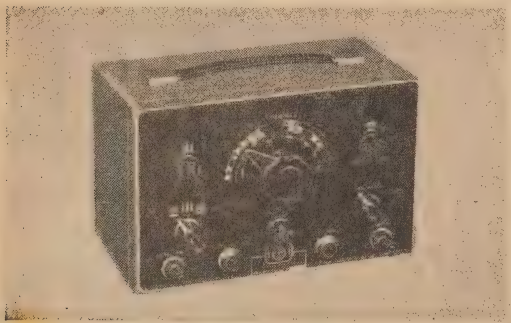
Electronic Volt Ohmmeter (V.T.V.M.) Model TVR-EV (BELOW)

This smartly styled Electronic Volt Ohmmeter is suitable for TV and radio servicing and employs a large 8-inch illuminated meter. It will measure negative D.C. voltage, positive D.C. voltage and A.C. voltage in steps of 1, 3, 10, 30, 100, 300 and 1,000 self-contained. Peak-to-peak A.C. voltages may be measured up to 2,800 volts. There are seven ranges of resistance up to 1,000 megohms and the D.C. voltages can be extended to 30,000 volts by use of the external probe Model TV30. Crystal probe and valve probe enable RF voltages up to 1,000 to be checked, and the wide frequency response makes it entirely suitable for TV servicing and other applications.



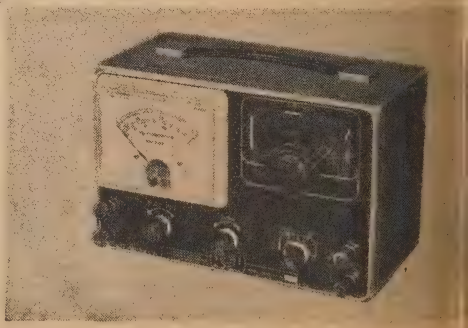
Pattern Generator, Model TVR-PG (Below)

This instrument is one of the basic instruments required for testing and adjusting TV receivers, and produces RF or IF carrier waves, amplitude modulated by video signals to produce horizontal bars, vertical bars or cross dot pattern, comprising both horizontal bars and vertical rows of dots. The carrier frequency is from 30 to 40 and 50 to 110 megacycles in fundamentals, and 100 to 220 megacycles in second harmonics. Horizontal bars from 8 to 10 are available and vertical bars from 8 to 12. On cross dot pattern the number of horizontal bars can be varied from 7 to 20 and the number of vertical rows of dots from 8 to 12 by means of controls provided. Many new faetures make this attractive for TV service organisations.



Transistorised Field Strength Indicator and Aerial Compass, Model TVR/FS (Below)

For the installation of TV aerials for the best results it is necessary to have a Field Strength Indicator such as the one illustrated here. Entirely portable and self-contained this Transistorised Electronic RF Voltmeter helps in location and orientation of aerials, and simplifies installation and thi saves time. Privided with carrying strap to go around the neck or over the shoulder t leaves the hands free fo adjustment and for carrying the aerial provided with each field strength indicator. It covers from channel 2 to 1(continually tuneable and is calibrated in channel numbers Only 7lbs in weight it is light, easy to carry and is ruggedly constructed.



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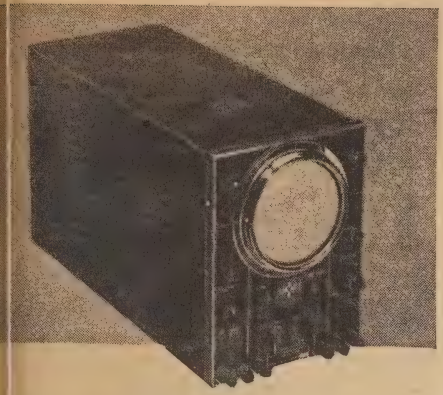
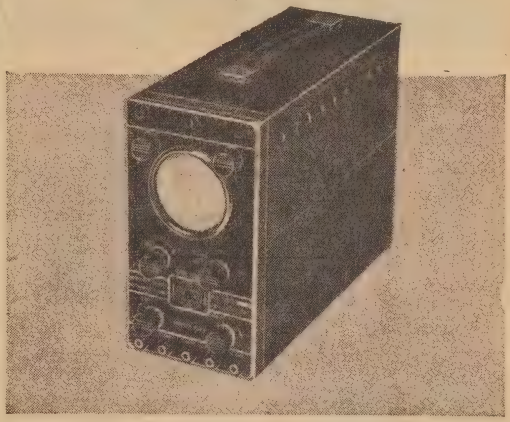


Oscilloscope 3-inch, Model TVR/C3 (above)

Built and portable; this Cathode Ray Oscilloscope is invaluable for TV and radio service work as well as industrial use. Although compact in size it contains the features of larger instruments, is flexible in use and offers many extra features. It is suitable for the visual alignment of TV receivers in conjunction with a sweep frequency oscillator, and direct access is possible to both horizontal and vertical plates for examination of strong voltages. It can be supplied with a demodulator probe for signal tracing work in TV chasses. Vertical amplifier response plus or minus 1 db from 10 cycles to 150 Kc, and 6 db down at 1 megacycle.

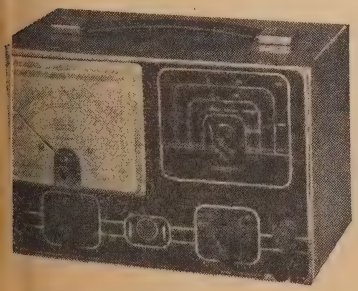
Oscilloscope 5-inch, Model TVR/C5 (below)

Specially designed for TV and radio servicing and for general purpose use at frequencies from 10 cycles to 6 megacycles per second. Accurately built and designed, it has many new features which makes it valuable for TV service work as well as general radio work and industrial use. Complete with instruction book and all necessary leads.



Multimeter (20,000 ohms per volt) Model TVR/MM

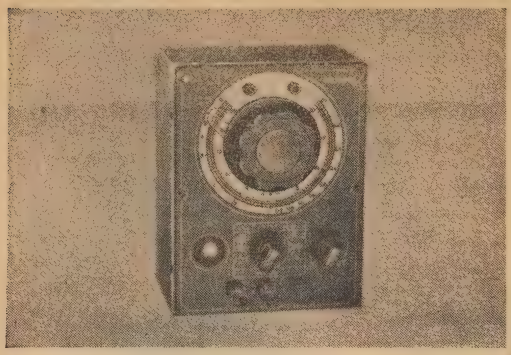
The new Multimeter built to the standards that University Instruments have laid down for many years, is designed as a quick checking portable instrument for TV and radio servicemen to carry with them. A.C. voltages, D.C. voltages and output voltages may be checked in ranges of 3, 10, 30, 100, 300 and 1,000 and there are six ranges of D.C. current from 100 microamperes up to 10 amperes. 5 ohms ranges allowing resistances from one half ohm up to 20 megohms to be checked are obtainable with self-contained batteries, and the large W4 all polystyrene meter is employed. Light in weight and readily portable, this rugged multimeter will be handy for all types of service.



TV TEST INSTRUMENTS

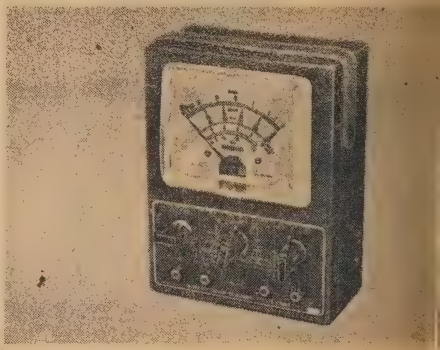
FROM

UNIVERSITY GRAHAM INSTRUMENTS PTY. LTD.



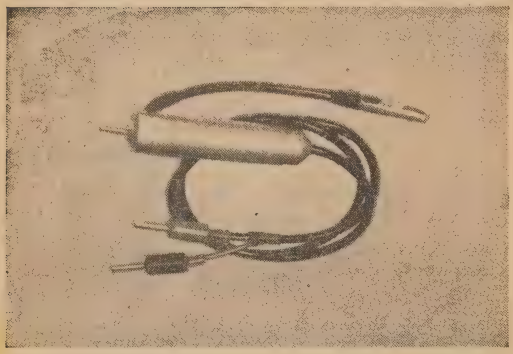
Resistance Capacity Tester, Model VBA

With the complex circuits in TV receivers employing many capacitors and many resistors, this special instrument provides a good standard of accuracy together with ease of handling. It covers an extensive range of resistance measurements from .1 ohm to 10 megohms and capacity measurements from 10 micro-microfarads to 10 microfarads. It is accurate and sensitive and is overload proof. A calibration system is incorporated to enable rapid checking of the apparatus of any instrument, and internal standards are adjusted to an accuracy of plus or minus 1 pc.



Multimeter (1,000 ohms per volt) Model MVA/2

This popular multimeter Model MVA/2 is well known to radio service organisations and industrial users all over the Commonwealth. Suitable for TV servicing, as well as ordinary radio servicing, it covers A.C., D.C. and output voltages up to 1,000 in several steps together with D.C. current ranges up to 10 amperes and self-contained resistance ranges up to 1 megohm. Readily portable and rugged in construction it will provide lasting accuracy and is supplied complete with all test leads and instruction booklet.



Demodulator Probe

This handy probe can be used with Oscilloscopes ty
C3 or C5 to enable signal tracing work to be carri
out in TV receivers and similar apparatus.

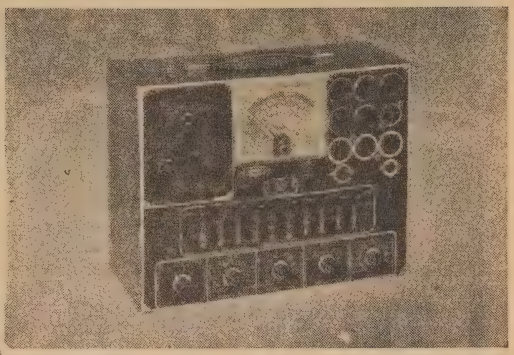
Picture Tube Adaptor

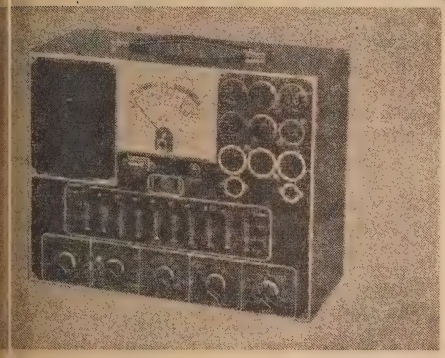
This flexible adaptor allows picture tubes
be tested without removing them from the
receivers, and is designed to be used
conjunction with testers Model TVT a
Model TST/2.

UNIVERSITY GRAHAM INSTRUMENTS PTY. LTD.

Valve Tester
Model TVT/

This is the latest in valve testers and is flexible over a very wide range allowing all types of tubes to be tested irrespective of their pin connections. Individual lever switches are used for every pin, and a range of twenty filament voltages allow all types of tubes to be tested quickly and accurately. It is designed for ordinary radio use as well as for testing TV tubes, and can be used as a portable instrument or bench instrument.





Valve and Circuit Tester
Model TST/2

The Model TST needs no introduction to the radio and TV service industry in Australia, and Model TST/2 is built on the same basic principles of good quality and lasting service, but with improvements to allow testing of TV tubes and to give it a more flexible range than TST. As well as having all the features of Model TVT valve tester, it allows AC/DC and output voltages to be checked up to 1,000 volts, together with a range of D.C. current up to 250 milliamperes and self-contained resistance ranges up to 10 megohm. Designed to operate from A.C. it is supplied with instruction booklet and test leads.

THER INSTRUMENTS INCLUDE:

- D.C. Multimeters
- A.C. Multimeters
- Oscillators
- Signal Tracers
- Resistance Testers
- Industrial Multimeters
- Sweep Oscillator and Market Generator to be ready shortly, etc.

UNIVERSITY GRAHAM
NSTRUMENTS PTY. LTD.,

5 North York Street,
SYDNEY

TV servicemen and service organisations:

You are invited to inspect our Television and radio test equipment under working conditions at our factory at 5 North York Street, Sydney, in a special demonstration room. We are situated in one of the arches under the Harbour Bridge, with easy parking facilities.

To:

University Graham Instruments Pty. Limited,
5 North York Street,
SYDNEY

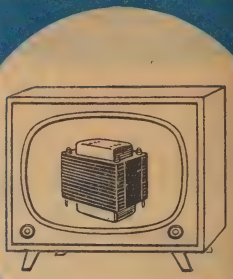
Please place me on your mailing list for TV and radio test equipment.

NAME .....

ADDRESS .....

.....

Ferguson



NEW RELEASE

TELEVISION COMPONENTS

As leaders in Australia in the development of transformers and chokes for the electronic industry Ferguson Transformers Pty. Ltd. have for some time been supplying components for television receivers to manufacturers, engineers, and T.V. training organisations.

Since very little information has been available to permit the construction of T.V. receivers by the experimenter, these components have not previously been offered to the trade generally.

However, a high performance T.V. receiver designed by Philips Electrical Industries Pty. Ltd. described in a recent Philips publication, and also in the May issue of Radio, Television and Hobbies is now creating a great deal of interest.

Ferguson transformers and chokes specially designed and tested in this receiver are now made available for those experimenters who have the advanced technical knowledge and access to other components and test equipment necessary for the construction and adjustment of a television receiver.

COMPONENTS FOR PHILIPS 17 INCH 700 T.V. RECEIVER

POWER TRANSFORMER (T1)

TYPE PF1129

(LOW RADIATION)

PRIMARY: 220-230-240V 50 CPS
H. T. SECONDARY: 235-0-235V 330 mA
L. T. SECONDARY: 6.3V 2A
6.3V 3.5A
6.3V 3.5A

Fitted with soft copper external shield and two covers with extended studs for flat mounting.

MAIN FILTER CHOKE (L1)

TYPE CF364

3 Henries 300 ma 50 ohms D.C.

AUXILIARY FILTER CHOKE (L2)

TYPE CF102

15 Henries 60 mA 300 ohms D.C.

FRAME TRANSFORMER (T3)

TYPE OP327

To couple 6BM8 valve to 10.4 mH deflection coils.

When other T.V. receiver designs are made available to the trade, Ferguson will be ready to supply transformers and chokes engineered and tested to meet the design requirements.

Insist on FERGUSON components for YOUR T.V. receiver

For further information contact your usual supplier.

FERGUSON LANE
CHATSWOOD

FERGUSON

TELEPHONES
JA 8491 (6 LINE)

Engineered TODAY for TOMORROW'S requirements

A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

OMPACT AMPLIFIER FEATURES NOVEL CIRCUIT

ader from Western Aus- Mr. J. A. Hazel of Ned- forwards the circuit of a quality push-pull amplifier can be built in a very space. We quote his

ome time I have been using air of 6AM5's in a compact nomical little amplifier. Re- owever, I was in need of an te compact amplifier of simi- r rating and the idea occurred using a pair of 6AB8's. The design is the result.

three valves in all are used, the rectifier, yet four watts lly undistorted audio can be for about 1 volt drive.

physical size of the amplifier more than that of the power ut transformers side by side. ase an output transformer of um fidelity class was used.

riodes of the 6AB8's are used ode follower inverter. Because mmon cathodes, back-bias was this requires, as far as extra nts are concerned, only the couplers for the triodes. These in the interests of greater since the feedback network to the input grid) returns to chain.

ER

ying the feedback to the grid he input impedance somewhat, to a really serious extent, and method of connection is really here.

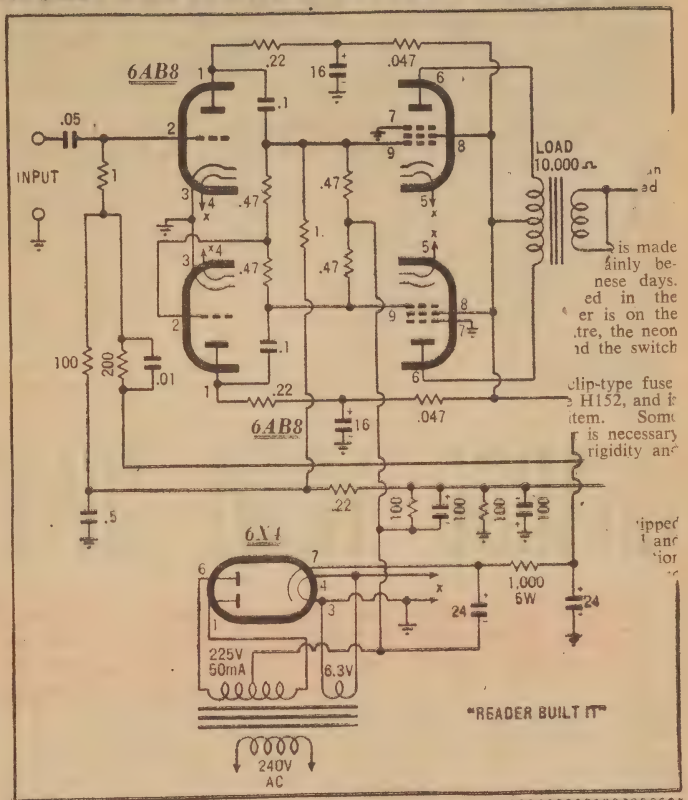
iniature 50 mA power trans- is used, and because of the rrent drain a resistance capacity quite satisfactory and saves ably on space.

with a tone control and com- unit or fed directly by a crys- up through a volume control amplifier, I find, leaves little sired up to its maximum power

6AB8 is directly equivalent to EL80 and therefore readers who have this valve on hand could the circuit as drawn here.

readers may wish to use the with low output pickups or ones. In the former case an al gain of from 10 to 20 may able and in the latter up to 00 times.

EF86 is suitable and may be a triode by connecting the o the plate and the suppressor athode or as a pentode.



is made
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clip-type fuse
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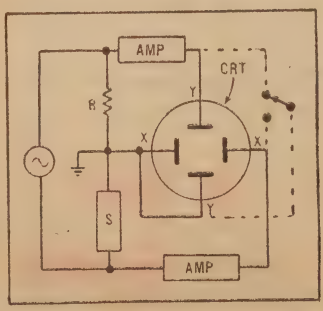
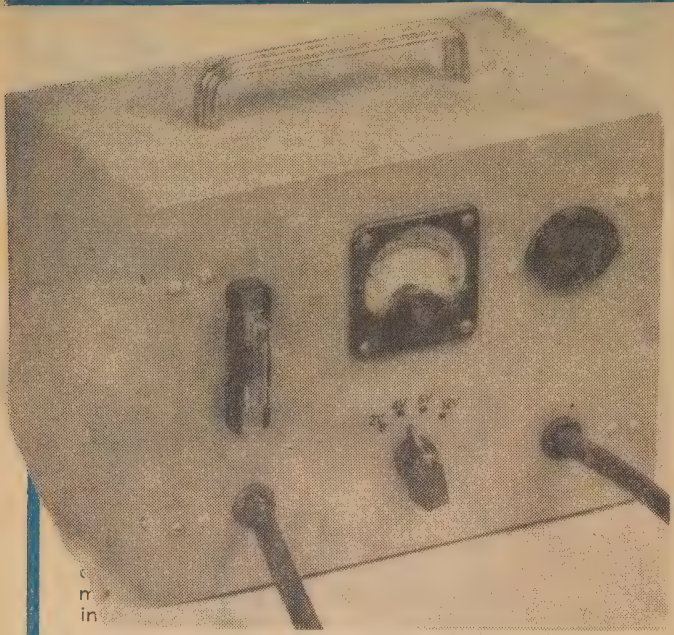
A CRO CURVE TRACING METHOD



A READER from Ultimo, NSW mentions that he has used his oscilloscope successfully for displaying the characteristic curves of non-linear devices on the screen of a cathode ray oscilloscope. He mentions particularly germanium diodes, but obviously valve curves and other interesting phenomena could be displayed in a similar manner.

The non-linear device under test is designated S and the symbolised generator may be a power transformer filament winding. The amplifier gain controls are adjusted to give suitable scales.

Zero axis may be added to the curve by shorting the deflector plates for a short part of each cycle, say, with the contacts of an ordinary vibrator.



ustrates the general attractiveness of the unit. Although an ammeter is not
avisary, we have photographed the charger with the meter fitted. Note the
selector switch, also the fuse on the left.

HARGE YOUR OWN BATTE

Here's an item which will be handy in any home workshop or garage — an inexpensive ba charger. Developed from our popular earlier design, this new version has a little more appeal and is easier to use. Specifications are essentially the same: it will charge batt from 2 to 12 volts at 3 amps.

by Wes Yashin

MOST car owners will be familiar with the circumstances which make a battery charger a handy device to have around.

A combination of short runs and lengthy parking periods can drain even the best battery. Leaving the parking lights on accidentally overnight, or the radio, is even a more effective way of draining it.

Perhaps the battery is not 100 pc and tends to drop its charge during a week of idleness.

Or maybe, there's another battery around the workshop, which needs to be topped up at intervals.

A NUISANCE

Putting up with a flat battery, or making repeat visits to the local garage is a poor proposition, when a small charger can boost a battery's condition overnight.

That's probably the reason why our first charger proved so popular, and why continuous requests for constructional information have induced us to present it again, with a few embellishments.

The design of a charger is largely dictated by the type of rectifier available.

Since we described the original charger, the rectifier position has not changed. The electrolytic type of rectifier can be ruled out as too "messy", while a valve type is not economical, because of its heavy filament drain.

This leaves a metal rectifier as the logical choice. These are very compact and require no other consideration but adequate ventilation.

Metal rectifiers have been available in three types, namely half-wave, full-wave, and the bridge type. In the model we selected the bridge type being a standard type, and one not too expensive. These are good supply and are likely to ren

Metal rectifiers fall into two opper oxide, of which the LT5 xample, and the selenium rectif

In a copper-oxide rectifier the ng action takes place between copper-oxide and pure copper; in the selenium rectifier, the re action takes place between the in face of selenium coated discs surface of the iron with which t n contact.

The application data for the vorth quoting, and you will n he tappings on the transformer t ccount the nett impedance of th ng circuit.

For one 2-volt cell the RMS f the transformer should be 8. or two 2-volt cells the RMS eeded is 10 volts; for three 2-v t should be 11.5 volts, and for si ells, 17 volts are required.

CURRENT RATING

The RMS figures given are pen circuit voltages at the tapp he transformer. The transforn ondary should be rated at an R ent of 1.4 times the DC mean

Selenium rectifiers are widel or industrial purposes, but are short supply, as far as home are concerned. A bridge type to the LT53 is available in very quantities and may be used, p

due consideration is given to the impedance, which is less than the LT53. It is capable of de an extra amp of charging curren

Our circuit follows recom practice for the LT53, and i straightforward. However, the ballast resistor is worth mentio

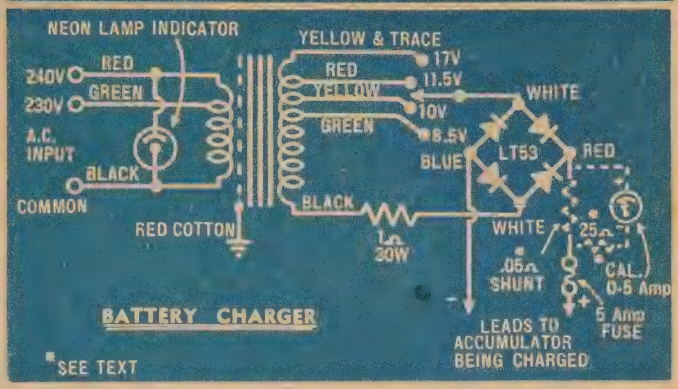
This resistor, in conjunction v effective resistance of the tran limits the peak and charging through the rectifier, being refer a "ballast".

DISSIPATION

It must obviously carry th amount of current as the tra secondary winding, which will times the mean DC current amperes.

Using Ohm's Law, the dissip found to be about 17 watts, charge current. We specified a resistor mainly because it is the standard size available, and beca advantageous, with regards to

CIRCUIT OF BATTERY CHARGER



The complete circuit diagram. The article explains how a 5mA. ex-disposals meter can be adapted to read charging current in amps. The meter face can be hand calibrated 0-5 amps.

iave the heat dissipated over a
:a.

or the constructional details, I carded the manual link switch e original, as being too cumber he switch used in its place is a rotary type, manufactured by ectrical Pty. Ltd. We were iat it would be made available through radio trade houses.

o considered the use of an Oak ch and were advised by the urers that its current-carrying should be adequate, provided of contacts were used in

s may have on hand a 2 x 4 single-deck switch. These may be used if the two sets of are connected in parallel. ey should be of the non-short- y, if they are to be manipulated charger is operating.

se of a shorting type switch ace a temporary short across sformer winding, which may the contacts or even blow a se. However, a switch of this be used, provided the charger ed off while the necessary volt- ge is being made.

ER CONNECTIONS

onnections to the rectifier are narked in the circuit diagram ne rectifier itself. The outgoing the battery are taken from the terminals marked red and blue is positive and the blue is nega

ve included a meter and a fusc with the positive lead, the meter entirely optional feature.

wn reason for including the indicate the charging current, is have to maintain a number of of various capacities. Some of small types with a restricted rate and a meter is necessary to iat the recommended rates are eded.

the charger is used for a speci- se, such as to keep a car bat- rim, or perhaps occasionally to radio type battery, there is no an indicating meter. The charg- nt will never exceed three amps drop automatically as the bat- ntial rises.

er, for the information of read- wish to follow our lead, we disposals type meter. It hap- be a 2in square type with a vement.

SHUNT

than go through an involved of measuring the meter resist- finally calculating the value of quired to convert the meter to nps full scale, we chose a simple ry method.

ng an arbitrary value of drop- stor, we duly wound one and permanently in series with the circuit. The value chosen was and consisted of 11ft 4in of 18 nel covered wire, wound on a bobbin (17a).

neter was then connected as a to read the voltage drop across t which, of course, becomes a of the current through it.

obbin was made up from two cheeks approximately ¼in in diameter, a threaded mounting pillar was used as a core, and the whole assembly held together by 1-8 screws.

To select the value of multiplier resistor to a reasonably close tolerance, it was necessary to wire a potentiometer temporarily as the multiplier resistor.

An ammeter known to be correct was then connected in series with the charging circuit and the potentiometer varied until the readings of the two coincided. The potentiometer was disconnected and the resistance required to give the correct deflection on the milliammeter, was measured. It happened to be 25 ohms in our case and a fixed resistor of this value was wired into circuit.

The advantages of this method are quite obvious. The value of the shunt is not highly critical though it must carry the current without overheating and without introducing too much resistance into the circuit. With the value we selected and the gauge of wire used there should be no appreciable heating, while the added resistance is quite small.

The second distinct advantage is that the meter is safeguarded. The charging current flows through the shunt and the meter is simply used to measure the voltage drop across it. Adjustments to the multiplier resistor can be carried out while it is in circuit, without likelihood of damage to the meter.

The panel on our new charger is made from 16-gauge aluminium, mainly because it is easy to obtain these days. The layout is clearly indicated in the photograph. The fuse-holder is on the left, the meter is in the centre, the neon indicator is on the right, and the switch is directly below the meter.

We have used an auto clip-type fuse holder; this is a Utilux type H152, and is a stock motor accessory item. Some alteration to the fuse-holder is necessary for the sake of mechanical rigidity and appearance.

MODIFICATIONS

As supplied, the fuse-holder is equipped with one screw terminal on one end and two on the other end. The alteration consists of cutting a portion off the end with the two terminals, to match the opposite end.

The fuse-holder was then stripped down, and a coat of black enamel applied to the bakelite.

The indicator lamp escutcheon was likewise treated to a coat of black enamel, to match the meter, against the grey background of the panel. (The escutcheon is actually sold for use with "magic-eye" tuning indicators, but it happens to fit the indicator lamps.)

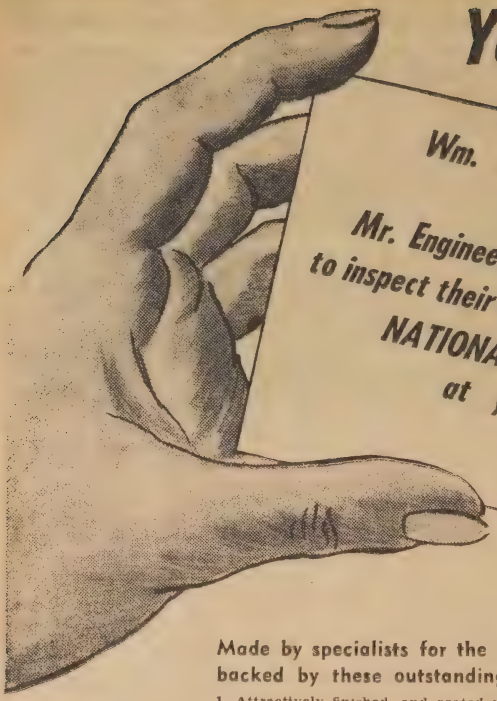
In order to keep connections to the fuse-holder behind the panel, we dis-

PARTS LIST

- 1 Standard instrument case 9⅛" x 6⅛" x 5½".
- 1 Front panel 9½" x 6⅛".
- 1 Panel mounting chassis, 7¾" x 5¼" x 1" with 5" side brackets.
- 1 Power transformer (Ferguson PF265 or similar. See text).
- 1 12-volt, 3-amp bridge type rectifier, LT53.
- 1 1 ohm 30-watt resistor.
- 1 Fuseholder (Utilux H 152 or similar).
- 1 Cordgrip BC adaptor.
- 1 250-volt ½watt indicator lamp.
- 1 1 x 4 single deck rotary switch (Paton Elec. or similar).
- 1 5ma meter movement (optional).
- 1 .05 ohm shunt, or 11ft. 4 in. of 18 swg and bobbin. (optional).
- 1 25-ohm resistor or alternative value to suit meter (see text).

SUNDRIES

Terminal strips (1-SM 25, 1-SM 22) 2 25-amp battery clips, 1-pointer knob, 2 lengths of 3-core cable, length of 18 gauge TC wire, length of spaghetti, 1 3-pin plug, piece of scrap metal for the indicator bracket, nuts and bolts, 5 grommets, etc.



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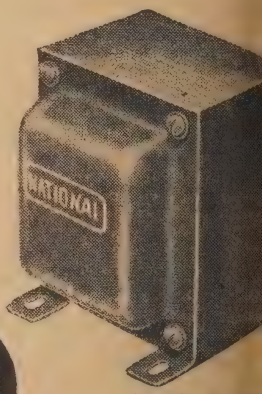
Wm. J. McLellan & Co. Pty. Ltd.
cordially invite you
Mr. Engineer, Mr. Serviceman, Mr. Hobbyist
to inspect their unexcelled range of upright and flat
NATIONAL POWER TRANSFORMERS
at your local supplier
R.S.V.P. for literature

Made by specialists for the specialist and backed by these outstanding features:—

1. Attractively finished, and coated with grey stoving enamel.
2. Special built-in features have completely eliminated lamination hum.
3. Scientifically placed louvres permit up-draughts of cool air past windings, thus ensuring lower working temperature and added safety.
4. Special anchoring method prevents leads being pulled out.
5. Modulation hum is virtually eliminated by inversely connective high tension secondary windings combined with an electro-static shield.



6. Coil is impr
with special varn
baked to resist h
7. Available in
excelled range
right and flat ty
tween 40 and 25
both radio and a
applications.

National
POWER TRANSFORMERS

LOOK BETTER ··· ARE BETTER

AUSTRALIAN & OVERSEAS AGENTS:

WM. J. McLELLAN & CO. PTY. LTD.

126 SUSSEX ST., (50 YARDS NORTH OF KING ST.), SYDNEY. BX1131

UPRIGHT or FLAT—there's a type for every application

existing screw terminals and
ead, 1-8in x ⅜in brass bolts
g behind the panel.

late them, we drilled the panel
lf-inch diameter bakelite washe
are retained in place by a
-8in bakelite, cut and drilled
n with the hole spacing of the
r.

ND CHASSIS

ugs are placed under the re
ts, and the appropriate connec
to these.

nt panel and the attached tray
is carry all the components
hole unit fits into a standard
case. Blueprints will be made
or the usual fee, and a set will
ied to the chassis manufactu

information of readers who
ssess an instrument case, it ha
fied slightly to provide furthe
holes.

ws of ½-inch holes have been
ng the back, spaced ¼ an inch
about 3-8in from the top and
ges. In addition to these, four
ter holes were drilled along
n of the case, directly below
r, and another four below the
istor.

e should be stood off the bench
feet or the ventilation will be
Standing the case on slat
ther improve matters.

to the actual construction side
gree that there is very little to
The over- and under-chassis
rly indicate where everything

mounting the transformer.
the leads and pass them
e appropriate grommeted holes
former is held by 3-16th inch
gh 1-8in bolts should be ade
uming washers under the bol

ORMER LEADS

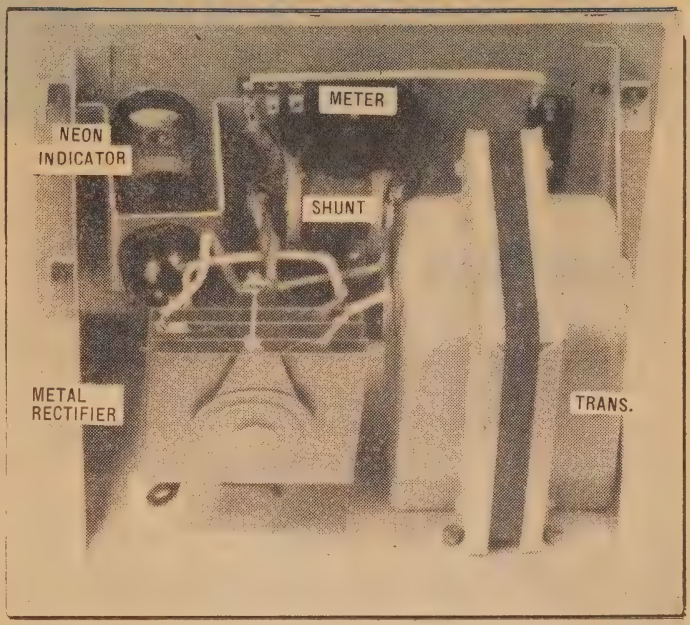
e leads out according to the
e, the primary leads can be
on the five lug strip, as also are
ing AC leads. The earth wire
ne wire from the internal shield
ed to the centre lug, which is
ne chassis by the same bolt as
er.

condary leads should be posi
proximately, trimmed to length
sulation pared back about 1-8in
scrape the enamel off and tin
ed wire.

ll notice that each tapping ha
; these must be scraped indi
inned, twisted together and sol
he appropriate switch positions
ds to the battery are best made
e-core cable, the same type as
the AC mains leads. They
clamped to the chassis at ap

nderneath view shows the trans-
wiring and the location of the
resistor. The terminal strip is
y the bolt securing the rectifier.
the clamp holding the incoming
cable. The bottom portion of the
switch is just visible.

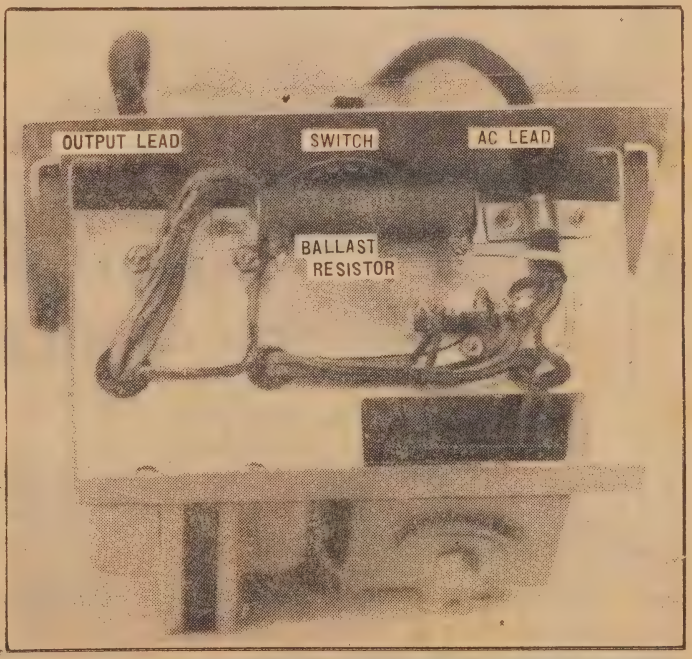
REAR AND UNDERNEATH VIEWS



The location of most of the components can be seen in this view. Note the cutout under the rectifier for ventilating purposes, and the tray type chassis used.

propriate points, in order to prevent any unintentional pull or strain from being transmitted to the connections.

Join the green and black wires together to form the negative lead. The remaining red lead is positive. This is done merely to retain some form of colour coding.



Listen . . .

GOODMANS Admittedly, the performance quality of a loudspeaker depends upon design and construction. But we know that you intend neither to design nor build one. You will select one already designed and built. And when you sit back to an evening of musical enjoyment, the chances are you won't be thinking of flux density, impedance or cone suspension. Certainly, the facts and figures are available for Goodmans High Fidelity Speakers . . . and we know they will impress you. But, the point we make is that you select your speaker as you intend to use it . . . not on paper but by critical listening. The more critical you are the more confident are we that your choice will be Goodmans—for the best reason in the world—

. . . because they sound better

Goodmans *High Fidelity*

LOUDSPEAKERS

made in England

GOODMANS H6 TRANSFORMERS

are specially designed for use with these Loud Speakers.

BRIEF SPECIFICATION

30 Watts Peak
Response +/- 1db
10—20,000 cps
Types available: 10,000 p to p to 15 oms, 15 to 600 ohms, 600 to 15 ohms.

SERVICE

We carry complete stocks of spare parts and repairs can be carried out in any capital city in the Commonwealth.

Ask for complete literature on the Goodman's Range

AVAILABLE FROM: All leading Distributors (A BRITISH MERCHANDISING PTY. LTD. AGENCY)

visable to have one lead shorter other, to minimise chance of hen hanging free. The 25-amp y clips are fitted to these leads. wiring runs between ballast ectifier and fuse, use at least tinned copper wire.

e type fuses, as used in the r, should be readily available. re rating should be adequate.

ere it is, quite straightforward ut any major problems. The lved represents but a few hours'

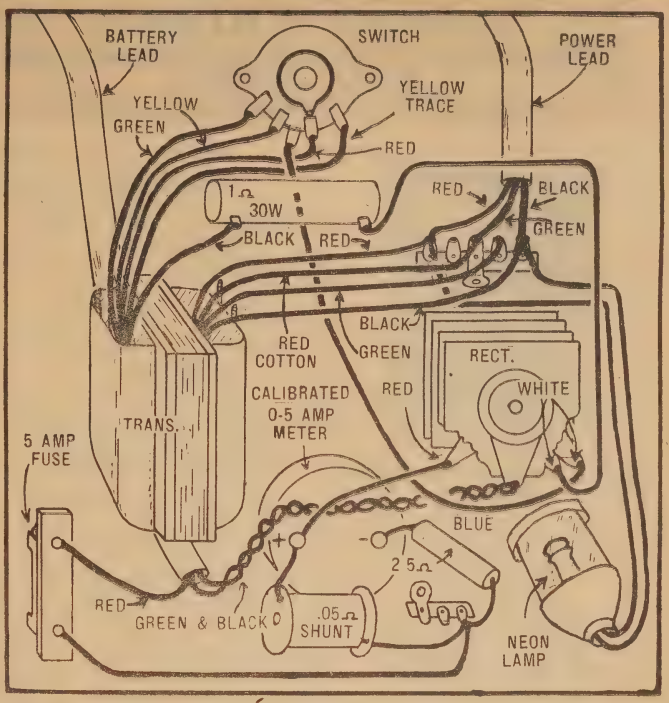
ished charger is often best in- a small shelf handy to where of the family car comes to rest. can then be clipped directly battery terminals or between and some suitable active point r's electrical system.

ING RATE

normal conditions, the charger er 3 amps to a near-flat bat- harge rate tapering off to about the battery comes up to full voltage.

e the chassis taken away and the would look something like this. you cannot read a schematic you should be able to follow this diagram. Though we suggest you our layout for the sake of con- e, it can be varied if there is a reason for doing so. Layout is not its performance, as is the case with a radio receiver.

DIAGRAM SHOWS CONNECTIONS



notorists will not want to bother rometers and/or voltmeters to ccurate check on the battery's and will be content to accept or on lights and starter as an as to whether the battery needs

the charger on over an even- om one evening to the next plenty to bring the battery ition where the car's own elec- em will readily top it off.

't forget the charger, and leave ull charge for a week at a time. t leave it on anyway after the as begun to gas freely.

appens that a charging rate as 5 amp can be obtained with a cumulator and the charger on t position. This is a handy charge condition, which may be certain cases. Unfortunately, it ork out quite so nicely on 12 charge rate on lower switch eing of little practical value.

TION OF BATTERY

ore precise method is required mining the condition of an ac- r, the specific gravity may be with a hydrometer. Terminal eadings, too, give some indica- he battery is under a nominal

should be some relationship be- specific gravity and the terminal A fully-charged battery should terminal voltage of 2.5 to 2.7 cell (about 2.3 for an old bat- is figure may drop to 2.2 volts or slightly less immediately the charging current is removed.

The specific gravity of a fully-charged accumulator should be in the vicinity of 1270. The recommended figure will vary in different localities, being higher for cold climates and lower for hot climates.

If there is a large discrepancy between the actual specific gravity, when the accumulator is fully charged, and the recommended figure, it could indicate that a large quantity of spilled electrolyte has been replaced by water or that strong electrolyte has been added. Whatever the cause, it is necessary that the specific gravity be adjusted.

If it is necessary to mix fresh electrolyte, always remember that water should never be added to acid in the mixing process. Always add acid to water.

When using the charger, make doubly sure that the leads are connected to the appropriate terminals on the battery; that is, positive to positive, and negative to negative. Otherwise there is a possibility of damaging the rectifier.

Automatic Monitor

(Continued from Page 23)

movement and weave of the film as it passes over heads. It is nevertheless quite possible to keep the summation of all discrepancies well below the limit which might otherwise be set for "perfect" copies.

Since the error indication on the meter is continuous during printing, the operator can correct through the reel for small discrepancies caused by slight changes in film sensitivity or amplifier drift.

If the amount of correction exceeds plus or minus 2db the probability of unsatisfactory striping is indicated.

Distinct from the printer as described, an auxiliary apparatus is used to check the exact synchronism of picture and sound. This involves adding a short piece of tone track alongside three designated pictures at the end of each reel.

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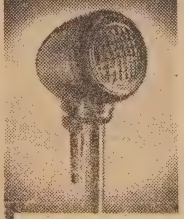
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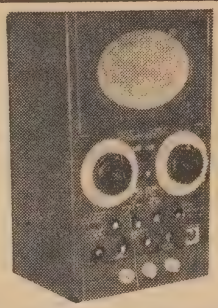

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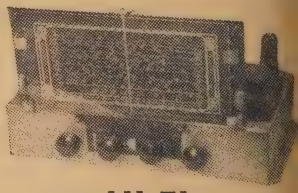

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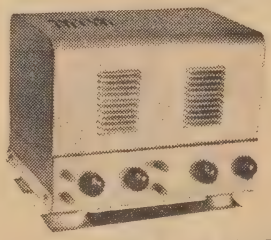

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COURSE IN TELEVISION

PART THIRTEEN — IF AMPLIFIER CHANNELS

lowing the discussion in recent issues of front-end tuners, we pass logically to a consider-on of IF amplifier systems. The reader must have some knowledge of the design problems olved in the IF channel before he can possibly appreciate the reason for the critical alignment instructions given in servicing data.

not far from the truth to sug- that the IF channel in a tele- receiver resembles in name only nterpart in a conventional AM st receiver.

latter operates normally at a ly low frequency — usually 455 t handles a simple signal at this ncy, amplitude modulated to a andwidth of less than 20 Kc. All rmer windings are peaked at the equency and the precise shape of ctivity curve which results seldom anyone but the initial designer.

nst this, the IF amplifier in a tele- receiver must operate at a very equency, if only by reason of the at the video signal is modulated to overall bandwidth of about six ycles, in the Australian vestigial d system.

obviously the intermediate fre- must be high enough to act as rier" for modulation components order and the minimum frequency can be considered must be set at times 6 megacycles.

n, there is the question of image e to be considered because a tele- receiver, like any other superhet, responsive to unwanted signals happen to be removed from the one by twice the intermediate ncy.

problem is accentuated by the at it is not easy to provide a high of selectivity ahead of the mixer evision receiver. There are mech- and electrical problems, as we have seen and, in any case, a fairly band characteristic has to be pro- o avoid loss of the higher modu- frequencies from the desired

CE OF FREQUENCY

these grounds, a very high inter- e frequency would appear to be antage.

ever, complications could arise utting the IF up among the signal ls. Furthermore, the earlier refer- o "several times 6 megacycles" envisages operation in a region valve and amplifier performance is ng sensitive to stray capacitance d inductance.

r all, for these same reasons, we ong accepted 13 metres as a very raveband and as the practical limit ch domestic dual-wave receivers made to tune. Yet 13 metres, ent to 23 megacycles, is plainly west order of frequency which be considered for television IF ls.

In actual fact, the Posmaster General's Department, which is the administering body in Australia for such affairs, has suggested that receiver manufacturers adopt the region just above 30 megacycles for the intermediate frequency of Australian television receivers.

It has suggested further, that they standardise on the practice of operating the local oscillator at all times on the high frequency side of the signal, which means that any possible image interference must come from transmissions 60-70 Mc above the desired channel.

In making these recommendations, the department has endeavored to arrange matters so that there is the least chance of strong local signals penetrating directly into the receiver's IF channel. Further, that the television channels in each area are least likely to cause mutual interference by image phenomena.

WISE POLICY

There is no compulsion about these recommendations but the wisdom of conforming to them is undoubted. It has been further stated as policy that the department will not feel obliged to intervene where other services cause interference in receivers not conforming to standard practice.

However, some further explanation is necessary at this stage, of the figure previously quoted for the IF channel.

In a modern television receiver, it is necessary to consider not one but two intermediate frequencies, one for sound and one for picture. These are produced when the respective signals beat with the local oscillator in the receiver. Since the original signals are 5.5 Mc apart, the same separation must be evident in the resultant intermediate frequencies.

The precise frequencies nominated as standard by the PMG Dept. are 30.5 Mc for the sound IF and 36 Mc for the picture IF.

NATURE OF CURVE

By way of example, the National stations in Sydney and Melbourne have been allotted the channel 63-70 Mc. The use of frequencies must be in accord with standard practice, as indicated in figure 80.

Thus the picture carrier will be located 1.25 Mc above the lower limit of the channel, notably 64.25 Mc.

The sound carrier will be 5.5 Mc above this, or 69.75 Mc.

To receive the station accurately, it would be necessary to set the receiver's local oscillator to 100.25 Mc.

Beating this frequency against the picture carrier at 64.25 would produce a difference frequency of 36 Mc.

Beating the local oscillator against the sound carrier at 69.75 would produce a difference frequency of 30.5 Mc.

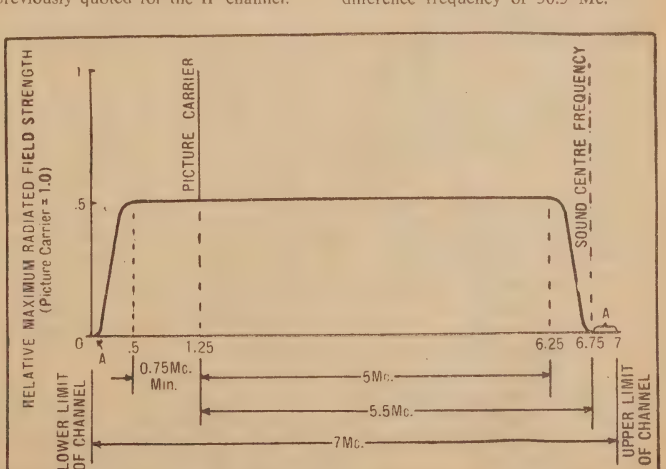

Figure 80: Originally appearing as figure 39, this diagram shows the manner in which each station must use its allotted channel. The signals appear in the receiver's IF system as indicated in figure 81.

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R & H

A point of immediate interest is that the use of a local oscillator frequency higher than the signal frequencies inverts their relative positions in the IF channel, the picture IF being higher than the sound IF. See figure 81.

The distribution of sideband energy is also inverted, as illustrated. Thus the main sideband energy relating to the picture is contained in the region 31 to 36 Mc. The partially suppressed sideband

At first glance it might appear the IF channel merely needs to h response which is substantially fla ped and wide enough to include a frequencies implied by figure 81— a little over 30 to just under 37 M

Such is not the case because, to with, the IF channel has to effec necessary compensation for the ve sideband transmission.

Referring again to figure 80, i

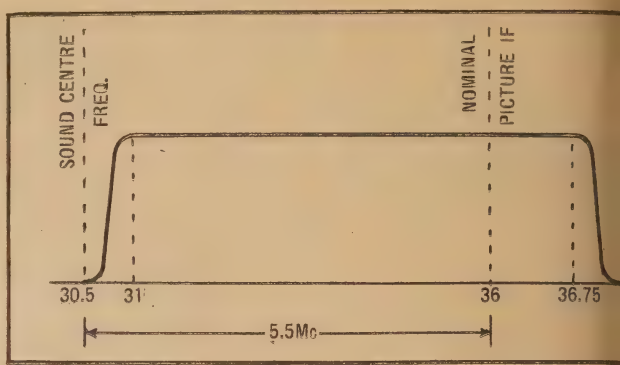

Figure 81: This diagram illustrates the relative positions of the sound and pic carriers, with their sidebands, in the receiver's IF channel. Note that the posit are inverted relative to the original signals.

is between 36 Mc and a little over 36.75.

As previously stated, the sound IF is 30.5 Mc but this will have sideband energy distributed to either side in accordance with the frequency modulation imposed thereon.

The IF system must take account of all these frequencies, if the full content of the sound and picture is to be retained. It cannot therefore be resonated to a single frequency, as happens in a normal broadcast receiver. Rather must the channel be designed to be responsive over a band of frequencies several megacycles wide.

This involves the possible use of techniques which have hitherto concerned radio servicemen very little. The techniques include:

(1) Windings loaded to reduce their "Q" factor and selectivity by specific amounts.

(2) Tuned circuits with high L/C ratios, again to achieve a broader response curve.

(3) Overcoupled tuned circuits to give a double-humped bandpass effect.

(4) Circuits tuned to staggered (or different) frequencies to give an overall response of the required shape.

(5) "Trap" absorption circuits to increase the attenuation at certain frequencies.

SELECTIVITY CURVE

Before looking more closely at these techniques, it will be necessary first to define the type of selectivity curve which is required in a television receiver.

Since this largely depends on the IF channel, as in any other superhet, it becomes largely a question of defining the response required from this portion of a television receiver.

be noted that the lower sideband picture carrier is not completely pressed. Only the modulation co ents beyond about 0.8 of a meg are filtered out, the lower freq modulation components being unaff

The signal available to the IF ch (figure 81) has similar characte except that the position of the side is inverted.

If a carrier, so modulated, is a to a detector, modulation compo representing frequencies up to 0. are reconstituted from the energy tained in both sidebands. On the hand, modulation components repr ing frequencies higher than abou Mc are reconstituted from one sid only, so that they have only ha amplitude.

LEVEL IS REDUCED

In other words, their level is re by 6 db and the output from the detector would have the general acteristic illustrated in figure 82. higher frequency components whic tribute fine detail to the picture been reduced in level by 6 db.

While it might conceivably be p to effect some compensation fo effect in the receiver's video am circuits, the normal approach achieve the result by utilising the or less natural response curve of amplifier.

The basic idea behind this sta will, in point of fact, be familiar t readers.

If a normal broadcast receiver is to one side of resonance (mis-tu other words) the bass is attenuate the high frequencies are accen giving a lisping, sibilant qual speech.

What actually happens is tha tuning puts the carrier (or the re

ne slope of the selectivity curve, ure 83a. The carrier therefore ttenuation, along with the low y sidebands which are adjacent

ver, one set of sidebands pro- the higher modulation frequen- ncides with the "nose" of the d is very much accentuated in In consequence, these side- quencies produce a higher out- n the detector than the much d lower sidebands—hence the Bass and the predominance of

elevision receiver, this situation d rather than avoided and the is correctly tuned when the pic- rier is located part way up a r side of the selectivity curve.

CE RESTORED

result of this deliberate pro- the modulation components nding to the lower video fre- are attenuated, while the higher quencies are accentuated.

lly enough, exact compensation assymetric transmission charac- annot be obtained by haphazard- to one side of an unspecified curve and certain standards d for.

ealised receiver would have a characteristic as illustrated in b.

ing that the tuning was adjust- duce the carrier (or its 36 Mc tant) to 50 pc of maximum e, the curve would have a slope rom near zero at 36.75 Mc to imum at 35.25 Mc.

curve would reduce the out- n the lower video modulation nts by 6 db and compensate or the emphasis they receive dur- mission.

ack of response beyond 36.75 he further advantage of render- eceiver insensitive to unwanted djacent to but outside the par- levision channel.

esponse curve extending down- m 35.25 Mc should ideally be Mc, so that it will pass, with- uation, the sidebands produced modulation components up to With such a curve, the receiver would deliver to the video cir- exact replica of the video signal applied to the picture carrier.

F RECEIVER

ptimum shape of the selectivity eyond the picture signal pass pends on the basic design of ver.

practice was to separate the d picture resultants after the after an early IF amplifier This was usually accomplished ecting two IF transformer in series in the appropriate ult.

uned broadly to the picture IF, ds to a picture IF channel and the video detector.

esponse curve of this channel lly adjusted to include as much icture information as possible e same time, to give maximum on at the sound intermediate y.

rsely, the sound IF resultant rted through its own channel M demodulator, the response of this section being only as wide as necessary for the purpose.

Figure 84a indicates the ideal IF characteristic for a "split-sound" receiver.

The solid curve is for the picture IF channel and it will be noted that the shape of the curve adjacent to the carrier position conforms to requirements already stated. (Figure 83b.)

At the other extreme, the pass-band allows for side bands spaced 5Mc or thereabouts from the carrier position, with rapid attenuation beyond that.

The dotted curve is for the separate sound IF channel, which is assumed to be wide enough overall and in respect to the discriminator characteristic to handle a deviation of plus and minus 50Kc.

Though many excellent receivers were built using the "split" or dual IF channels the system has certain notable disadvantages:

DISADVANTAGES

(1) It requires two complete IF channels and is therefore not economical in terms of valves and components.

(2) Frequency drift is a serious problem, because of the high carrier frequencies and the relatively narrow deviation. A degree of mistuning which does not markedly affect the picture can produce hopeless distortion from the FM sound channel.

(3) In difficult locations, tuning the picture carrier more into the IF passband is often helpful but it is impractical to do this if it means distortion in the sound channel or even complete loss of sound.

Because it offers a way out of these difficulties, the so-called "intercarrier" system has been widely adopted for multi-channel TV receivers.

In an intercarrier receiver, the picture and sound IF resultants are passed right through a common IF channel to the video detector. To make this possible, the passband of the channel must be wide enough to accommodate both signals.

Because the detector is a non-linear device, it not only extracts the video component—which is its prime function—but it produces a beat between the picture and sound signals in the IF system.

5.5Mc BEAT

Since the two carriers (and their re sultants) are spaced 5.5Mc apart, a beat occurs at this frequency and is sufficiently close to the normal video range of frequencies to appear in the detector's output and in the video amplifier system.

The vital point about this 5.5Mc beat is that it contains the FM component of the original sound channel. This is obvious enough because, if the sound IF deviates, so must also the difference frequency.

A tuned circuit suffices to extract the 5.5Mc component, often called a "subcarrier", from the video system and to divert it to a simple intercarrier limiter-

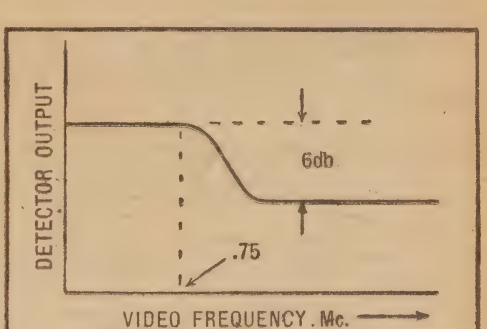

Figure 82: Because of the vestigial sideband transmission, video output from the detector tends to be greater at the low frequencies than at the high frequencies, compensation for this effect is necessary in the receiver.

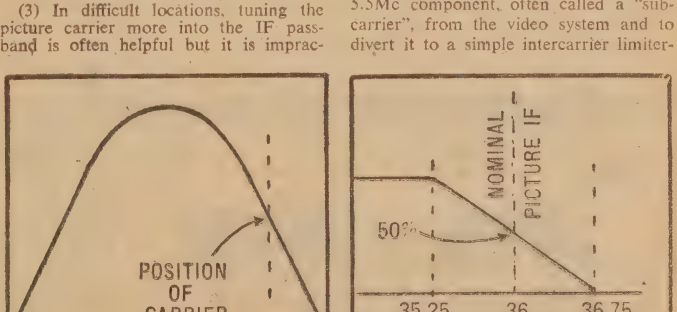

Figure 83: Most listeners are aware of the effect in a broadcast receiver of tuning to one side of the carrier (a). In a television receiver this is normal procedure, the selectivity curve being shaped as indicated in (b).

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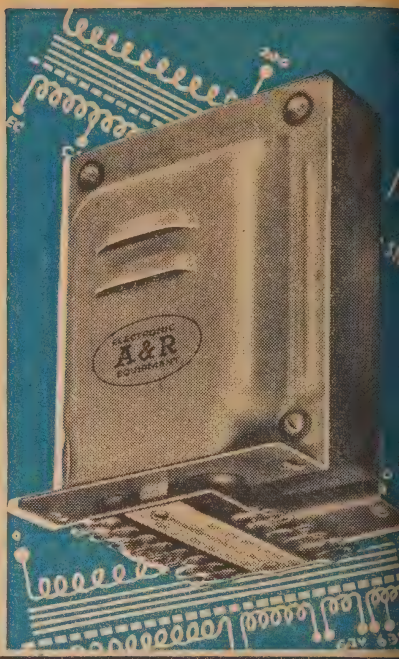

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1767	"	" " "	300 — CT — 300	5v—2A; 2 x 6.3v—2A.
1768	"	" " "	325 — CT — 325	
1769	"	" " "	350 — CT — 350	
1770	"	" " "	385 — CT — 385	
1771	150	200 — 230 — 240	285 — CT — 285	5v—3A; 6.3v—2A; 6.3v—CT—2A
1772	"	" " "	325 — CT — 325	ditto
1773	"	" " "	350 — CT — 350	5v—3A; 6.3v—3A; 6.3v—CT—3A
1774	"	" " "	350 — CT — 350	5v—3A; 6.3v—CT—3A; 2.5v—5A
1775	"	" " "	385 — CT — 385	5v—3A; 6.3v—3A; 6.3v—CT—3A
1776	175	200 — 230 — 240	285 — CT — 285	
1777	"	" " "	325 — CT — 325	
1778	"	" " "	350 — CT — 350	All in this Section
1779	"	" " "	385 — CT — 385	
1780	200	" " "	350 — CT — 350	5v—3A; 6.3v—3A; 6.3v—CT—3A
1781	200	" " "	400 — CT — 400	
1782	200	" " "	450 — CT — 450	
1400	250	200—220—230—240	565, 500, 425 A side	2 x 6.3v—3A; 2 x 2.5v—3A; 5v—
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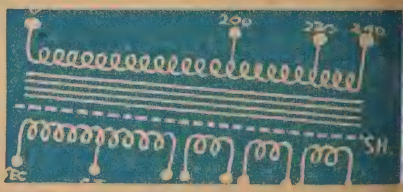

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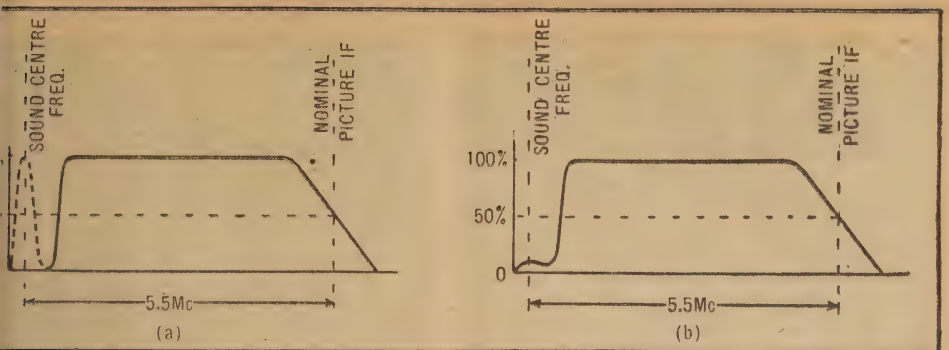

84: Diagram (a) illustrates an idealised IF response curve for a "split-sound" receiver, (b) the curve for the more usual intercarrier type.

and FM demodulator tuned to

nomy is a major requirement, fe component can be extracted e plate circuit of the video . After being thus amplified ith the regular video signals, a ined amplifier is usually suf- head of the demodulator.

economy is less important, a e channel fed directly from the gives more certain separation l and picture information.

OMPONENT

picture modulation which may nt on the sub-carrier is removed imiter-amplifier and the natural ristics of the FM demodulator. e FM sound modulation is re- nd this is passed on through a ntrol to the audio amplifier

e the sub-carrier could cause if it reached the picture tube s normal practice to include a uned trap circuit just ahead of ure tube to block the 5.5Mc nt. Since it operates beyond the f video frequencies normally ed, with the trap circuit does not with the quality of the picture. e of the popularity of inter- ype receivers, television stations ired to maintain within very nits the 5.5Mc frequency differ- tween sound and picture car-

JM CARRIER

rmore, in order that the inter- eat shall not be interrupted at , the stations must ensure that modulation on peak white g negative modulation) shall minish the carrier amplitude to 10 pc of its peak value.

lid, the intercarrier beat could and the sound be interrupted which would produce a spuri- e component in the speaker. tain best all-round performance, sirable to shape the IF char- as per figure 84b, with a which will pass the sound IF at lower amplitude than the arrier.

t, figure 84b answers the quest- ch was posed earlier in the rcgarding the optimum selectiv- for a television receiver.

And how does the intercarrier principle overcome the difficulties listed earlier for a "split-sound" receiver?

Firstly, it eliminates one complete high frequency IF channel, replacing it with a much abbreviated channel operating at 5.5Mc. It therefore represents a worthwhile economy in design.

What is more important, the input to the FM sound demodulator is centred strictly at 5.5Mc, being the frequency difference between two highly stable sources — the picture transmitter and the sound transmitter.

Tuning the receiver does not alter the frequency, it only tunes it in or out.

If the FM discriminator transformer in the receiver has itself been accurately prealigned to 5.5Mc, it must accept the 5.5Mc sub-carrier and operate in conjunction with the demodulator tube to produce a distortion-free audio signal.

Thus incorrect tuning of an intercarrier type receiver does not produce distorted sound. It is quite practical to tune the receiver for the best picture and allow the sound to appear along with it.

By the same token moderate frequency drift has no drastic effect on the sound quality and retuning is only necessary if picture and sound alike deteriorate markedly.

(To be continued)

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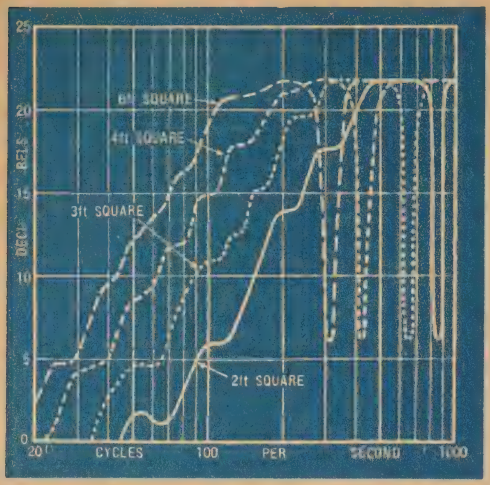

Figure 1: This diagram illustrates the natural limit which is imposed upon the bass response by flat baffles of various dimensions. Even a 6ft square baffle is relatively poor and the need for something better is obvious.

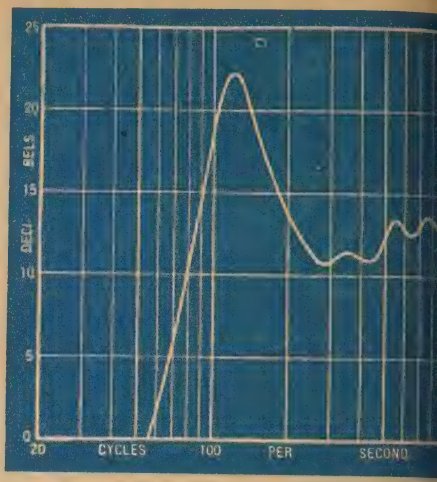

Figure 3: The kind of response which can occur in a backed cabinet, when cabinet and speaker characteristics to produce a single prominent peak in the bass register. note bass" results.

SPEAKER BAFFLING METHOD

Despite all that has been written in the past, the subject of loudspeaker enclosures—particularly vented enclosures—is one which continues to exercise the minds of readers. This arti is intended as a general summary and as a guide for those who are planning to build an closure to meet their own requirements.

MOST of the information which follows has already been published at one time or another, but stocks of back issues and reprint articles have long since been exhausted. Some preliminary discussion of the subject should therefore be helpful.

A loudspeaker which is required to reproduce the lower audio frequencies must be provided with a baffle of one kind or another.

BASIC IDEAS

This arises from the fact that, when the speaker is reproducing low frequencies, the cone moves backward and forward at a relatively slow rate.

Air, which is compressed on one face of the cone, tends merely to flow around the edge to the other face, and sound-pressure waves are not propagated over a useful distance from the speaker.

The lower the frequency of cone oscillation, the more obvious does this effect become, so that, in practice, sound output diminishes with frequency.

By providing the speaker with a baffle, the free interchange of pressure between the front and rear of the cone is impeded and low frequency sound energy is radiated more effectively into the listening room.

Baffle systems may be divided broadly into two types:

(1) Those in which the baffle is intended merely to segregate the front and rear radiation, the latter being regarded as a liability.

(2) Those in which an attempt is made to utilise the rear radiation — generally to reinforce radiation from the front of the cone.

Group (1) will be discussed first.

The simplest form of baffle is a flat board, with a hole for the speaker cut somewhere near its centre. A flat baffle provides some segregation of the front and rear radiation and extends the effective low frequency response downward to a degree which is directly related to the dimensions of the baffle.

FLAT BAFFLES

Figure 1, reprinted from an earlier issue, shows the kind of low frequency response which can be expected from a speaker mounted on flat baffles of different dimensions.

It indicates that the response is maintained down to a frequency where the air path around the edge of the baffle approximates a full wavelength, at which point there is a sharp dip in the curve.

The response returns to normal below this critical frequency, but only for about an octave. At a frequency where path around the baffle is less th a wavelength, it begins finally to to a rate approximating 6db per

This represents a general pat behavior. In practice, the precis of the response curve below the point may be modified somewhat b dimensions of the baffle, by its p in the room, and by the size and ance characteristics of the spea

However, it is quite obvious these curves that a prohibitively baffle would be required to ensure response down to 30 cps. For t son, flat baffles are rarely used fidelity is a first requirement.

The one case where a "flat baff an attraction is where the speak be mounted in a wall, with the the cone facing into another roo at the very least, into a large clo

HAS ADVANTAGES

The scheme has obvious limitat the average home, but, where app can give good results and co space in the room. It approach theoretical situation of the speake mounted on a baffle of infinite

The wall must naturally be fre vibration and resonance effects a

should be let into it so that the
ge of the cone is as close as pos-
the wall surface on the listening-
de. It is generally inadvisable to
e speaker working through an air
equal to the thickness of the wall.
ning complete segregation of the
d rear cone radiation (the latter
st as far as the listening-room is
ed), the final response is then
a function of the speaker's own
characteristics.

ER RESPONSE

frequencies will be dispersed
g to the speaker's directivity
and its position in the room.
frequency response will be gov-
y the cone's area and movement
its natural resonance character-

larger the speaker under such
ns, the better will be the bass
e. Thus, a 15-inch woofer can
ected to maintain its efficiency
a lower frequency than a 12-
e, but both will be substantially
an a 10-inch or 8-inch type.
or more small speakers, operat-
ther, will be better than a single
peaker of equivalent design, be-
their greater total cone area.

point behind this statement is
ith a wall or baffle-mounted
its cone provides the only
of coupling to the air in the
room, and the final efficiency
dent on the ratio of cone dimen-
acoustic wavelength.

e 2 shows the order of response
an be expected from single 8-
2-inch and 15-inch loudspeakers
d on a flat baffle of "infinite"
ons — a situation which wall
g approaches.

ning up, it can be concluded that
nounted speaker system can give
sults, provided:

nat the wall is rigid and suitably
ed for good sound dispersal in
n.

hat adequate cone area is pro-
either a single 15 or 12-inch
or multiple smaller speakers.

hat the amplifier is of modern
nd capable of limiting natural
sonance.

OSURES

st cases, however, neither a flat
or wall mounting can be consid-
th the result that the speaker
e mounted in some kind of box
sure, which therefore doubles as
and an item of furniture, with
ons to both functions.

nost elementary type of enclo-
in open-backed box—a descrip-
ch happens to fit an ordinary
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es some separation of the front
radiation, but is only equiva-
his respect, to a baffle of mod-
se.

is equally important is the fact
such enclosure tends to acquire
tic resonance of its own, which
the speaker's characteristics in
register.

t result can be very unfortunate
et resonance, air path and
resonance coincide to provide
of curve shown in figure 3,
nted from an earlier issue. The
e and obvious effect of such a

response is to turn bass energy into a prominent one-note thump.

This often passes as good bass response, but, in fact, it is just the reverse.

On the other hand, reproduction can be made reasonably good in such circumstances by using a good quality speaker with a low cone resonance (say 45-50cps) and by applying a discreet amount of low frequency boost. Provided the power limit is maintained with-

by W. N. Williams

in the capacity of the speaker, the response can be sustained down to the cone resonance frequency.

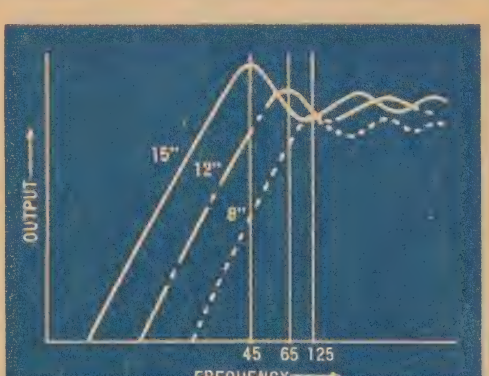
However, as a general rule, the use of an open-backed cabinet is not good practice in a system from which good fidelity is required.

The apparent alternative of closing up the back of the cabinet must also be approached with caution.

Even though sealing the back suppresses the rear radiation, and even though sealed boxes are frequently (and wrongly) called "infinite" baffles, their effect on the speaker is quite different from mounting it on a wall, which does indeed simulate "infinite-baffle" conditions.

Unless the box or cabinet is of very generous proportions, movement of the cone at low frequencies has to produce a substantial cyclic change in the pressure of the air trapped inside.

Figure 2: Bass response relates as shown to the total area of the cone. Ambitious multiple-speaker set-ups often use 15-inch woofers, though some overseas enthusiasts show a preference for as many as four 8-inch wide-range speakers, operating in parallel and mounted in a common enclosure.



Air compressed as the cone moves back tries to expand and push it forward again. Conversely, reduced internal pressure as the cone moves outward, invites atmospheric pressure to push it back again.

The result is a kind of acoustic spring, which stiffens the movement of the cone and appreciably raises its resonant frequency. Thus a speaker, which has a resonance of say 50 cps in free air, may show a peak at 75 cps or higher in a small box and produce very disappointing sound as a result.

A further difficulty can arise from the fact that certain dimensions within the box will be equivalent to multiples of a half-wavelength at certain frequencies, leading to spurious loading upon — and output from — the speaker cone.

As a general rule, enclosed boxes are best used with speakers having a very low cone resonant frequency, notably cloth surround types with a resonance in the region of 20 cps.

A substantial rise in cone resonance is therefore possible before it intrudes markedly into the useful spectrum. Internal reflections are minimised by liberal padding with sound-absorbent material and by staggering the dimensions of the box.

Enclosures of this general nature are often the subject of debate and criticism, their exponents claiming faithful bass response, while opponents claim a lack of bass. In many cases, there is an element of truth in both points of view.

Limited cone area and the loading on it imposed by the box may, in fact, limit the acoustic efficiency of the system, in line with figure 2. At the same time, suppression of resonance effects can unjustly be put down to lack of bass by a listener who has grown to accept resonant bass reproduction as a "standard".

In short, the pitfalls of a fully enclosed box — wrongly called an infinite baffle — can only be avoided if used with speaker intended for the purpose and in a box constructed according to proven specifications.

A variant of the completely enclosed box is the so-called "Boffle" suggested by H. A. Hartley, and illustrated in figure 4. In this device, the space behind the speaker is occupied by a succession of sound-absorbent screens, made up from thick underfelt, stretched on wooden frames.

Each screen has cut in it a circular hole of different dimensions, aligned behind the speaker. The rear screen has no hole.

Hartley's idea is that the succession of screens should prevent the build-up of wave reflections inside the enclosure. Further that they should absorb most of the rear radiation, whilst retaining sufficient compliance to avoid a completely constricted air load on the rear of the cone.

The "Boffle" principle has enjoyed a certain amount of popularity and has

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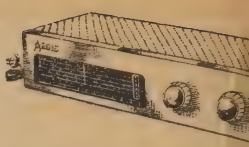

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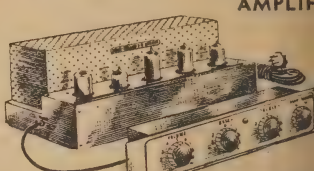

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en suggested by Hartley as a f improving the characteristics of cked cabinets. Ventilation prob- ay arise, of course, if the absor- reens should hinder ventilation ifier equipment.

l have become obvious from all going discussion that the cabinet le) cannot be considered as an vice to house the loudspeaker. It very real part in determining the ult and must be regarded as an artner with the speaker in the ropagating sound into the listen- n.

s is true of the baffle systems ave thus far been discussed, it with even greater force to the general class of baffle or enclos- se which seek to do more than or suppress the rear radiation; hich seek rather to utilise this to reinforce that from the front one.

eat many enclosure designs have olved and publicised which seek

Figure 4 right: Illustrating the basic idea of the Hartley "Boffle"—an enclosure which is not completely sealed but which contains a progression of absorbent screens, with holes of varying diameters.

Figure 5 left: Illustrating the electrical equivalent circuit, much simplified, for a speaker and a vented enclosure. The curve below shows the effect of a resonant enclosure on an equally resonant speaker.

ve this objective — probably into hundreds. To build, test and t on even the more important uld be a formidable task and neral comment can be made in tumns.

SURE TYPES

er enclosures of the general class subdivided into three main

orn types.
coustic labyrinth types.
rivations of the Helmholtz onator.

horn loudspeakers are seldom domestic listening, except as quency tweeters. Adapted for e-oduction the horn usually be- very much folded affair, formed ttern of shelves and partitions rectangular cabinet.

horns of this general type were nly regarded by high fidelity en- formed by partitions and shelves, till they emerge through a fairly large aperture in the front of the cabinet and just below the speaker position.

An attempt is usually made to have the cross-sectional area of this rear path increase in the manner of a horn radiator but, because of the circuitous path and internal padding, only the frequencies below about 200 cps. are transmitted through it.

For these lower frequencies, however, the horn provides a coupling medium to the air in the listening room and, under ideal circumstances, allows the low frequency efficiency of the system to be maintained.

Curves published for enclosures combining direct radiation with a folded bass horn, show that a very smooth characteristic can be obtained with careful design.

Such characteristics are certainly not attained automatically. A variety of possible complications can be suggested which can limit performance in a poor design:

(1) Internal reflections from the sharp discontinuities of the horn may impose spurious loading on the rear of the cone.

(2) Increased efficiency due to the horn can boost the output over a limited sector in the bass region.

(3) Inadequate mouth dimensions may sharply restrict the efficiency at the lowest frequencies.

(4) Phase interference between radiation from the horn and the front of the cone may introduce peaks and troughs in the response.

(5) The horn may fail to load the cone at its resonance, where loading is most required.

By way of general comment, it would appear that folded horns are seen to best advantage when designed around a high-quality speaker of about 8-inch diameter. This has certainly been the basis of most well-engineered designs published in the past.

"Scaling up" to suit larger speakers can result in a very cumbersome device.

"Scaling down" to achieve economy of size or labor can invite troubles of the type listed.

So much for the conventional folded horn.

THE LABYRINTH

The acoustic labyrinth idea is externally rather similar to the direct-radiator-folded-horn enclosure just discussed. The difference is that the shelves and partitions behind the speaker form an air column or fairly constant cross-section, ending in a vent of about the same area as the speaker cone.

The column is generally padded inside to limit reflections and propagation through it, except at very low frequencies.

The usual design approach to labyrinth enclosure is to select a speaker with a moderately low cone resonance—say about 40 cps. The column is made then a quarter wavelength long at this frequency.

Because it then constitutes an open quarter-wave pipe, it loads the speaker

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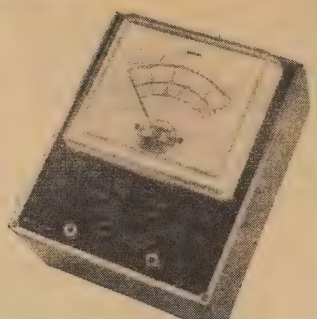

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cone heavily at its resonance an places its single impedance peak two much smaller peaks similar to commonly ascribed to the vented e ure, which has yet to be discussed.

At about an octave above this quency, the pipe represents a half- which inverts the phase of the radiation and therefore reinforce natural radiation from the front c cone.

Under favorable circumstances, th effect can be decidedly beneficial. ever, it is equally obvious that the combination of speaker and encl can produce rather erratic impe and response curves. The same also result from arbitrarily reducing length of the labyrinth for the sa economy.

A little consideration of the prec paragraphs must lead to the concl that a folded horn, which is too stricted for one reason or another, not be far removed in operation fr labyrinth.

By the same reasoning, a laby which is too constricted must app the behavior of a nearly-sealed padded box, like the "Boffle".

In most cases, the result ma judged as acceptable and as a bi improvement over a simple baff cabinet. However, its mode of tion may be a lot more ambiguou fraught with chance, than the con tor imagines.

VENTED ENCLOSURES

The third major class of enclosu derived from the Helmholtz reso and the Vented or Reflex enclosu the best known example. It is far and away the most popular of enclosure with high fidelity e siasts nowadays, because of its plicity and effectiveness.

The vented or reflex enclosu simply a large, sturdy box of spe volume with two holes in its front —one to mount the speaker and other as an open vent. All other or openings are sealed, the larger p are braced internally and the inner faces padded.

Such an enclosure exhibits an a tic resonance, which is dependen the enclosure volume and the d sions of the vent—or more cor the mass of air in the vent.

The classic approach is to desig enclosure so that it resonates same frequency as the natural co sonance of the speaker. The effects then interact in the manu two closely-coupled electrically circuits as, for example, an overc IF transformer.

The single resonance peak is re by two much smaller peaks, one t side of the original resonance frec

Electrically, we describe it as a pass" effect.

Acoustically, it can serve to p a flatter and broader characteri the region of cone resonance.

On an engineering basis, at design problems are often solve electrical formula by transcribing tic quantities like volume, ma stiffness to capacitance, inductan sistance, &c., while the expressi is retained to describe the prop of the resonance characteristic.

Thus we encounter diagram figure 5, where the speaker and sure are compared with series an

onant circuits respectively; where
the natural speaker impedance
dotted) is replaced by the im-
e curve (shown solid) when the
peaker is mounted in a comple-
y enclosure.

those who may find this analogy
t to follow, an alternative expla-
is offered by A. B. Cohen in his
book "Hi-Fi Loudspeakers And
ures." See figure 6.

low frequency wavefront in-
the pressure at the input to a
chamber (figure 6), there will not
iately be a movement of air
the output vent. Pressure must
lt up in the chamber first be-
ch a movement will become evi-

ever, once the air in and around
nt is accelerated, its inertia tends
o it moving, even after the inter-
ssure has been relieved. In fact,
the output vent may even con-
o move outwards for a period
he wavefront at the input port
versed.

NGE IN PHASE

ther words, the time lag which
roduced can put the radiation
ne output vent out of phase with
tial sound source.

analogy with electrical quantities
s immediately obvious. The
effect of the enclosure is equiva-
capacitance, the inertia of air
output vent to inductance, while
al losses are obviously equiva-
resistance.

as there is a natural resonance
ticular combinations of L, C and
s there an acoustic resonance for
rticular conditions envisaged in
6. At this resonant frequency
a maximum of acoustic activity
enclosure and vent, while output
ne vent is a complete half-cycle
phase with the input.

ractical enclosure, as per figure
ally the same as figure 6.

gy is fed into the enclosure from
r side of the speaker cone, which
nted in its front face. This is
und in" port.

"sound out" vent is also in the
the cabinet and radiates into the
g room.

chief difference is that the in-
f the enclosure is heavily padded,
ately to absorb the higher fre-
s and to prevent internal reflec-
Thus, over the entire upper re-
useful sound energy is radiated
om the front of the cone.

R FREQUENCIES

rd the low end of the spectrum,
below about 150-200 cps, the
ion becomes less effective and the
re begins to play an active part
ound propagation.

reaches a maximum in the de-
region of cabinet resonance,
as previously stated, energy de-
rom the rear of the cone is in-
through 180 degrees to emerge
ne vent in phase with that from
it of the cone.

he surface, this would suggest a
ost effect, but it must be remem-
hat it occurs at frequencies where
efficiency might otherwise be
due to limited area of the cone

tendency to improve acoustic coupling and efficiency at the low frequencies is therefore similar to what happens in a labyrinth or a folded horn, though different principles are involved.

The weight of opinon these days is that the enclosure accomplishes the desired result to a satisfactory degree and much more simply than the other types. However, as with the labyrinth and horn, awkward questions can be posed:

What guarantee can there be that proper resonance will be obtained from an enclosure of given dimensions?

What sets the optimum relationship of volume and port area for any given resonance? (The "L/C ratio", in other words).

How can the resonance Q (or "live-

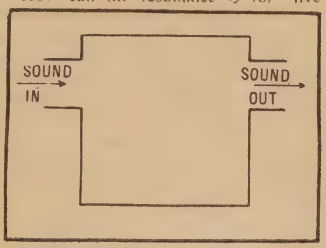

Figure 6: An enclosure may be envisaged as a box with a "sound in" and a "sound out" port. See text.

ness") of the enclosure be matched to that of the speaker? Could not the cure be worse than the complaint?

Strangely enough, this last major objection to a vented enclosure is also its saving feature.

Modern, high-quality loud-speakers, used in conjunction with triode and/or feedback amplifiers, do not exhibit a prominent bass resonance, by reason of the high electrical damping which is present.

Therefore, the enclosure resonance should likewise be heavily damped. This is accomplished partly by slagging the interior walls but more particularly by placing a cloth membrane across the centre of the enclosure and/or across the vent opening.

Instead of matching one prominent resonance curve to another prominent resonance curve, it is merely a matter of mating two very broad characteristics. Under these conditions, the whole design becomes non-critical and the "penalty" for error a very small one.

In fact, more than one authority has suggested that, with a heavily-damped speaker and enclosure, the calculated volume may be regarded merely as a minimum figure and that some increase over and above this is all to the good.

The reasoning is that the total damping on the speaker will be sufficient anyway and that a larger enclosure will improve wave propagation well below the natural capabilities of the speaker.

From being a critically-tuned resonant chamber, the vented enclosure is thus modified into a large padded box, which retains sufficient of its phase reversing properties to assist the speaker at very low frequencies.

(Perhaps we should call it a "Voffle", equivalent to a vented-box-baffle and obtained by inter-breeding a sealed box, a Boffle and a vented enclosure.)

In most cases, enthusiasts are not able to indulge any such whims for large enclosures and the usual approach is to build to optimum dimensions and no larger.

CONSTRUCTION

Figure 7 indicates the shape of the usual rectangular vented enclosure. It is shown vertically but can rest on its longer side if need be.

The vent may simply be a hole cut in the front face of the cabinet or it may be built up into a short internal tunnel, as indicated. Extending the vent in this fashion increases the mass of the air in the vent and allows the same resonance to be achieved with a smaller enclosure volume.

We shall refer to this again a little later.

To be successful, an enclosure must be built of stout timber, either heavy plywood or of T and G boards which are well enough seasoned not to shrink after assembly. Nothing less than ¾in timber can be recommended.

It is desirable to brace the larger surfaces with timber glued and screwed edgewise, to prevent drumming. All surfaces should be glued and screwed together, except for the rear, which needs

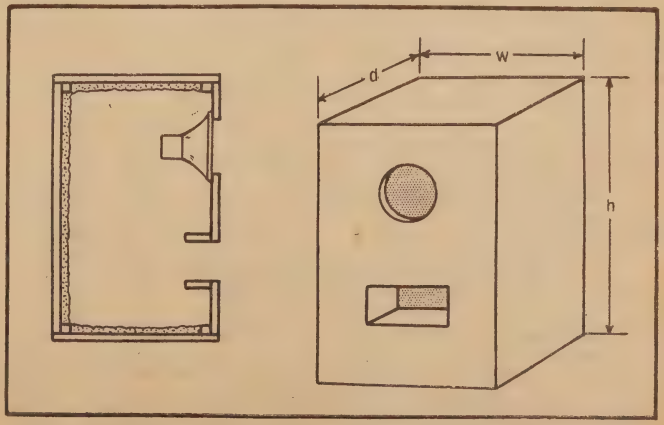

Figure 7: The construction of a practical vented enclosure. A light, acoustically transparent cloth is usually stretched over the front face, tacked under cover mould, to improve the appearance.

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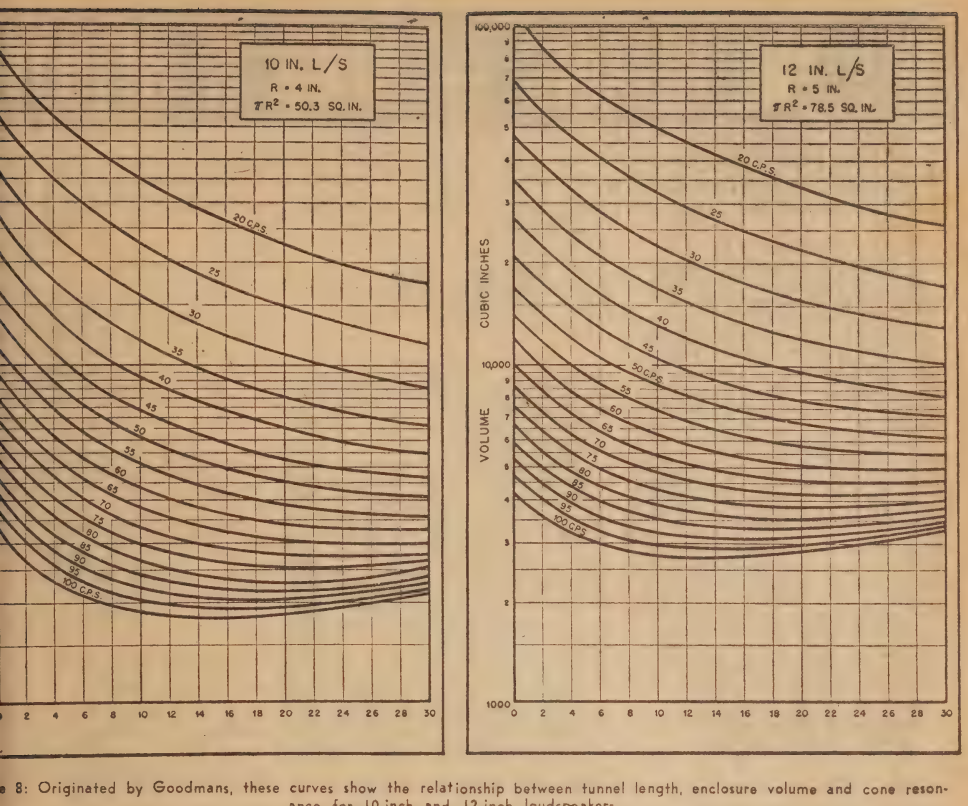

e 8: Originated by Goodmans, these curves show the relationship between tunnel length, enclosure volume and cone resonance for 10-inch and 12-inch loudspeakers.

movable for access to the cabinet. ust be screwed solidly to the op and bottom, to form an air-attle-free joint.

overall proportions are not criti- ough it is wise to avoid a tall, closure or a near-cube. Recom- proportions are in the ratios h (d) to width (w) to height (h) 1.7 : 2.5.

ever the ratios, however, the lume, after allowing for braces, me of the speaker itself and the e if any should be equal to the figure. No acount need be taken internal padding, if this is of variety, such as heavy underfelt.

GULAR ENCLOSURES

sures are often made triangular plan view so that they will fit corner. Actually this shape has ng to recommend it, because the l of both low and high frequen- often better when they originate corner, rather than from the f a flat wall.

nsions have to be manipulated, se, to retain the correct internal

speaker opening must suit the and will usually need to be cut inside diameter of the gasket ting the cone.

vent is usually made equal in the active area of the speaker This is generally less than the total area of the speaker cutout, the active cone extending to about halfway across the outer compliant support.

The vent can be of any convenient shape and size but the usual course is to make it about as long as the speaker cutout is wide and as high as necessary to obtain the requisite area.

Its position on the front panel is not critical but a position intermediate between the speaker cutout and the bottom of the cabinet is usually adopted.

Much data has been published about the volume of enclosures but one of the most convenient references are a set of curves originated by Goodman's Engineers and reprinted from our April, 1952, issue. They are given here as figure 8, and show the relationship between the tunnel length, enclosure volume and cone resonance for 10-inch 12-inch speakers.

HOW TO DESIGN

The procedure to use these curves is quite simple:

(1) Select the speaker and determine its resonant frequency by reference to the manufacturer's data or by observation, if the necessary equipment is available.

(2) Decide on the general shape and size of enclosure which you can accommodate in your room. As a guide, total internal volume will need to be about 6 cu .ft. for a 12-inch speaker, a little less for a 10-inch speaker.

(3) Change this to cubic inches, remembering that there are 1728 cubic inches to the cubic foot.

(4) Check the volume on the curves to note whether it cuts the speaker resonance curve at a point representing a practical length for the tunnel. If it does, you have guessed well and you can proceed to replace your approximations with more exact measurements and derive an exact length for the tunnel.

ADJUSTMENTS

Contrariwise, if the tunnel needs to be too short (less than the thickness of the front panel) your cabinet is needlessly large. You can either leave as deliberately oversize—as per the earlier remarks—or you can reduce its internal volume.

If the throat needs to be longer than about six inches or comes too close to the rear face, the cabinet is too small. You will have to increase the volume and perhaps make the cabinet deeper at the same time.

This information should be sufficient to allow many readers to get on with the construction of a vented enclosure and you can be assured of good results from it.

But what of the R-J enclosure and others which have been mentioned from time to time? Space does not permit any further discussion just here but we may be able to add something more to these remarks in the next issue.

OFF THE RECORD — NEWS & REVIEWS

During my recent five months abroad, I naturally took every opportunity to hear and see a many performances as possible by artists who are featured on gramophone records. I als visited many of the major recording companies of the world to learn what I could of the facilities and methods.

by John Moyle

THE recording companies stretched across the world from Philips, at Baarn in Holland, to Capitol, in Hollywood, on the west coast of USA.

In between I managed to include the studios and factory of EMI, where HMV, Columbia, Parlophone, Brunswick, etc., originate, and the English Decca company, now one of the most powerful in the world.

In the USA, I spent some time with American Columbia, RCA Victor, Emory Cook (who, for his size, makes more noise in the record world than anybody else), Westminster, Mercury and Capitol.

In addition, I was able to inspect several other recording companies which make discs for firms that do not operate their own plants. Some of these outfits I found the most interesting of all, for they generally centred around some enthusiastic engineer to whom experiment was the breath of life, and to whom a production curve was not such a hard taskmaster as it is to larger factories.

I generally found these people much more willing to talk about their technical problems than the big firms, for whom technique plays a large part in competition, and is not a thing to be discussed unnecessarily.

For the moment, however, I want to make some comments about the people who make the music rather than those who manufacture the discs.

My first contact with a really important recording body was at La Scala, in Milan, where I was lucky enough to talk myself into a seat half an hour before the performance began.

Luckily, I found an old gentleman who looked as though he had been showing people into their seats for half a century, but whose main value to me was that he understood English.

He provided me with one of the best stalls in the house, to which I was duly ushered by an impressive individual in a long black gown with a silver cord around his neck, traditional dress at La Scala.

MAGNIFICENT LA SCALA

The newly-decorated theatre is magnificent, with its great proscenium, six tiers of scarlet "boxes" extending right up to the roof, and its great crystal chandelier.

When the house lights go down, the chandelier is the first to fade, leaving the boxes still illuminated around the horseshoe shape of the walls. And, as they, too, die away, and the great curtain sweeps up, there is created a moment of tight anticipation I have felt no else in the world.

The performance that day was let, so I did not hear any of the si whose world-famous names were tained on the notice-boards outsid rather unimpressive building facad did, however, hear the splendid or tra, and at some length, for the It believe in value for their money. ballets and a total of four hours the program, including Aurora's ding, just the thing to show of brilliance of the company and the q of its music.

The dancing and decor for each let were fabulous in the tradition world's most lavish theatre. Th chestra was good, but at the mom think it has its equals or even sup elsewhere. Nevertheless, that vis La Scala was very definitely a light!

Another famous orchestra was the Concertgebouw in Amste

Just before Easter it gave its tional performance of Bach's Matthew's Passion under its resident ductor, Eduard van Beinum.

The Concertgebouw is not a hall inside, having a very narrow cony with some awkward extensio the rear to increase its size. Thos ting at the very back cannot ever the stage. However, it is being vated, so I did not see it at its

CONCERTGEBOUW ACOUST

Acoustically it is extremely good ceiling is not high, and although it duces clear, bright sound, there is little echo to spoil the effect.

I can well understand its reput as one of the best halls in Europ

The soloists were of the highest including Ernst Haefliger as the E gelist and Heinz Rehfuss as Chr supported by the Toonkunstkoor of sterdam, numbering about 300, a smaller boy's choir.

Being a sacred work, there wa fuss or applause. At the appointed van Beinum came quietly to his from the back of the stage, lifte baton, and the performance began when it was over, he put it down as quietly and it was done.

But in the intervening hours we music which was truly unforgettabl

One cannot completely judge a chestra in a work of this type, but was no mistaking the sensitivity an quality of the players.

In this hall on another occas also heard the Utrecht Symphon chestra in a tight, precisely played gram. Its conductor, Paul Huppe a man who signals every entry an lines every move—I thought his o tra would have relaxed more if h let them do some of the work!

In Paris on several occasions able to visit the Opera House wi

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nt staircase and foyer where
's fashions make their parade
occasions.
chestra here played extremely
icularly during a performance
lagic Flute, which was one of
lavishly staged spectacles of the

pera House is famous for its
stage mechanisms, and its fast
cenery and disappearing stage
vere working overtime!
ic Flute which later I saw at
arden simply could not com-
it.
zing "light" scene in white and
which the opera ended has
ver been matched anywhere.
was in London that I heard
music. There does not appear
musical "season" in England,
ncert-going now centres around
val Hall.

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ooked for concerts and recitals
every night of the year, includ-
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d there is no subscription list.
es you can buy a ticket right
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orld's celebrities.
sign of this magnificent hall
of an article in itself, but its
y and its quality have un-
done more in recent years to
the musical life of England,
of Europe, than any other
tor.
ealth of concerts is due largely
mber of orchestras in England.
don there are the Royal Phil-
the London Philharmonic, the
ymphony, the Philharmonia and
Symphony, as well as some
rchestras.
London, but visiting the Fes-
quite frequently, are the Halle
from Manchester, the Liver-
lharmonic, the Bournemouth
and so on.

NNA PHILHARMONIC

st of these orchestras make
Europe, and in return London
from time to time the Vienna
s, of which there are three,
Orchestra, and so on.
t was in London the Vienna
nic Orchestra gave some con-

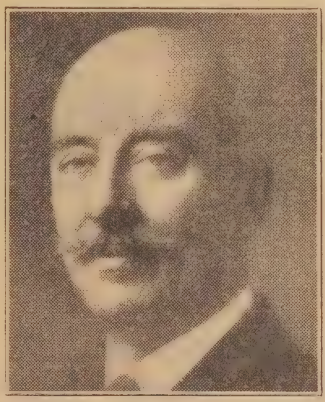
doubt this is the finest orch-
ve ever heard.
cision, flexibility, vitality and
nip under Kubelik (who is
nough to inspire a Boy Scout
a thing to marvel at.
from a Brahms concerto, to
have referred later on, they
the Dvorak 2nd Symphony a
masterpiece, but I think the
gave their wildest applause for
iic Dances which were played
es".
again will I believe that the
touch" is merely a myth. Of
h orchestras, I was impressed
he Philharmonia which, in its
oduce music comparable with
Orchestra. It gives fewer con-
the others, and is in great
r recording sessions which take
deal of its time.
ible to hear the Philharmonia
in recording sessions at the Kingsway Hall, which is much favored by EMI through whose good offices it was arranged.

Listening in this way, one soon becomes aware of deficiencies which a concert may not always reveal.

But I thought the Philharmonia virtually without a weakness. Apart from the first-class string section, I particularly admired the brass, which seems able to handle the most difficult passages with ease.

The Festival Hall is one place where a blurt from a horn, or a squawk from an oboe, just can't be hidden. For the sake of artistic reputations there had best not be any!

This sureness of touch makes the Philharmonia a delight to hear.



Sir Adrian Boult who recently conducted some fine London concerts of Vaughan Williams symphonies. The famous composer attends most of these concerts, and generally mounts the platform to take a bow.

For second place it would be hard to separate the Royal Philharmonic and the London Philharmonic. Weakest of the five I would place the BBC Orchestra at the present moment. I wonder whether the fact that it includes about 22 women players has anything to do with it? All the others are exclusively male!

Well up to London form I would rate the Halle Orchestra, which I heard with Barbirolli in its newly rebuilt Free Trades Hall.

It also has about 20 women players, including the drummer—one of the best and most energetic I have come across.

THE HALLE ORCHESTRA

At Manchester, the orchestra plays from a steeply rising "platform" so that each succeeding row of players is quite clear of the one in front.

This confronts the audience with a solid mass of instruments.

The night of my visit they played the 1812 Overture, supplemented by two brass bands, a total of about 140 people.

By some chance or courtesy, I had been given a seat in the front row of the balcony, about 40 feet from the first line of players.

My ears are somewhat hardened to sound, but they were put to the test that night. The hall is an extremely lively one and I have never heard such a noise, before or since!

In London I heard many soloists well

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us through records and per-
earance. Heifetz gave a mem-
rformance of the Sibelius Con-
mpoli played the Elgar rather
but most effectively, Claudio
s heard in Beethoven. In addi-
number of lesser-known local
s, Julius Katchen, Moira Lym-
za Anda, Backhaus (who un-
y I missed), Clifford Curzon,
rling, Friedrich Wuhrer and
Haas all gave concerts.
the conductors at these con-
e Sir Adrian Boult, Anthony
Kubelik, Paul Paray, Royalton
rbirolli, Sir Thomas Beecham.
nteux and Walter Goehr.

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the crucial question!
I say that, at its best, the Syd-
hony Orchestra as I knew it
left could quite easily match
formances I heard in London.
hink it has the poise and finish
the best Britain can produce;
ith all orchestras, its standard
direct proportion to its con-

ure the London orchestras are
ly overworked, and could not
ive adequate rehearsals to sup-
heavy programs. As a result,
tor with below-average per-
nds a lack of response which
break down.
f these famous orchestras can
ost any standard work with
shut, and maybe they some-

e them a fine conductor for
y have respect, and most of
play superbly.
ser acquaintance with musical
is the backbone of our record
as for me one of the most
things about my long journey.
to assemble some kind of a
dgment, there is no substitute

w for some of the discs await-
my return!

**HOVEN: Sonata No. 14 in
p Minor, Opus 27, No. 2
ght) and No. 26 in E Flat
Opus 81a (Les Adieux).
by Solomon. HMV
51.**

very close to being a magnifi-
d, and if you are an unquali-
er of Solomon you might easily
such.
n quarrel is with the pace of
ovement of the Moonlight.
is one of the few pianists
play successfully with a slow
gives him the opportunity to
s fine keyboard and pedal

el that sometimes he overdoes
When that happens, there is
that his audience will go to

y nearly happens in the Moon-
there is little else to carp at
see.
dles the Scherzo movement
ling judgment and taste, and,
t, mixes fire and poetry with
nd.
erse side contains a perform-
e Les Adieux which may well
ssed on records.
ately the piano tone isn't quite
y's best, and my copy showed
ak-up on loud chords. The
surface, too, isn't the dead quiet thing we look for in the top-notchers.

But you mustn't overlook it, on any account. It's a really fine disc.

MOZART: Piano Concertos in D Minor K466 and C Major K503. Played by Walter Gieseking and the Philharmonia Orchestra conducted by Hans Rosbaud. Columbia 330CX1235.

One of the best Mozart records I've ever heard.

Gieseking, in my view, hasn't been as successful with Mozart in the past as he has with Debussy, for instance, but here at least his performance is perfection itself.

His mood in both concertos is one of the utmost restraint; a miniature mood, but with strength and the utmost clarity for all its quietness.

In fact, it is this magical atmosphere of stillness, seen particularly in the slow movements, which is at once our joy, and surely the despair of so many aspiring performers who would give their ears to play that way.

The recording has supported the obvious intention of the players by using a fairly close mike on the piano so that its lightest touch is heard, and, in keeping, the orchestra, where there is no danger of its power becoming obtrusive.

This technique has taken dynamic control from the mixing panel and left it where it belongs, with the players.

Teamwork with the soloist, too, is above reproach, and their mutual timing is a delight to hear.

Except for one unfortunate defect in a quiet spot which may be on my copy only, the surface is completely quiet on the RIAA curve.

RIMSKY-KORSAKOV: Russian Easter Festival Overture; PROKOFIEV—Classical Symphony. Played by the Philadelphia Symphony Orchestra, conducted by Eugene Ormandy. Columbia 330C1025.

The tendency of American conductors to hard-drive their orchestras is well-exampled here. Ormandy is particular-

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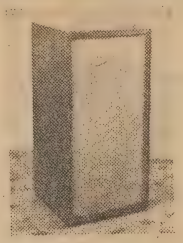

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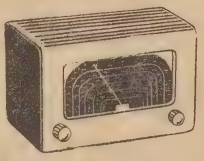

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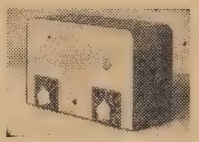

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at this kind of thing, and, if you then this record is for you.
nally, I think there is a limit nings. I feel that this mania for n and speed can become a bad over-riding the intent of the nd producing empty and profit- formances.

Classical Symphony is a neat and triguing little work, well worth ence from time to time, and, al- it can take a strait-jacket of outline better than some other tions, I think Ormandy has its pants far too severely.

Russian Easter Festival Overture nge work, and many might think oesn't much matter what is done

events, it has enough wild and plored moments to sound much nvincing when ground out of chine which seems to be the Philadelphia Orchestra.

ally it is very impressive, with f frequencies and a very wide range.

didn't find much music in it.

LTZ TIME IN VIENNA: l by Andre Kostelanetz and his stra. Columbia 33OS1049.

y pleasant record — just the r half an hour or so of easy and bright sound. It is Kos- rather than Vienna, but that orry most people.

ight selections are favorites so e is something for everybody.

a good, clean surface, a nice ss, and a well-balanced bass ould sound good on almost any-

ZART: Concerto No. 3 in G (K216); Concerto No. 7 in Major (K268). Played by ian Ferras (violin) and the rt Chamber Orchestra, con- by Karl Munchinger. Decca 5044.

e the extremely doubtful auth- of No. 7, it is still attributed to although anyone at all could difference between it and the g on the other side.

n't know why Ferras couldn't ected a better concerto, for he ously capable of dealing com- with any of them. In fact, to competent is to damn him with ise. He is far too good a vio- for that.

mpare this record with some made by men many years his to reveal only what one would ected, that there is a maturer surer touch which, when struck, e of a Mozart concerto sheer rfection.

ur, forward violin reproduction n occasional departure from in- a handful of notes which tends e a scramble, and so on, but 's also youth and freshness and musical mind. This record must n made at least eighteen months no one need be ashamed of

kl the strong, even tone which oduces—he will, I'm sure, learn xtra sweetness to his upper re- hich in this record becomes at n and colorless.

chestra plays well and tastefully. es nicely for weight, and man- asatisfying degree of bass and ne without being unduly heavy.

The surface is an excellent one, and, altogether, the record rates well.

GERSHWIN: Rhapsody In Blue; Concerto in F. Played by Julius Katchen (piano) and Mantovani and his Orchestra. Decca LXTA5069.

Like most sensible people, I fell for the Rhapsody In Blue when, in my extremely youthful days, I first heard it as given to the world by Paul Whiteman.

All that is ever written about it being a masterpiece is true—it shines among much music in the modern manner, written before and since, like a bright light in a very, very naughty world.

It is sublimely easy to claim a masterpiece in a welter of melody and harmony—or lack of it—which only the composer really understands. But the test of immortality is a pretty good one.

Julius Katchen

Many such efforts have been politely bowed in, and just as politely allowed mercifully to die.

But the Rhapsody won't die. It is the most successful effort to show the musical importance of jazz. It lives because it does so with originality, brilliance, melody, wit, clear thinking and the competence which goes with the man and his moment.

Gershwin never again wrote with such conviction. The Concerto in F makes the point. It's easy enough to hear, but

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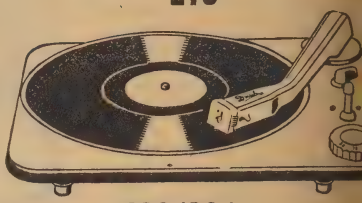

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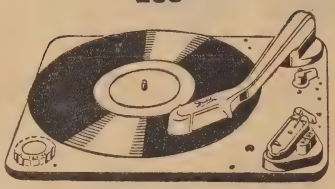

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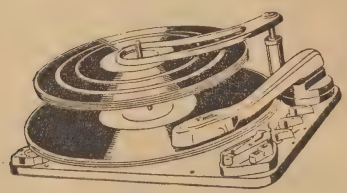

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You'll need a

't leave you with new ideas run-
ound your head as does the
ly, nor does it have that lift that
new thing live in your musical
ce.

st Gershwin trying to follow up
r and losing by a mile.
las! I can't commend this record
even a good example of either
tion.

und is really fine—Decca has
itself in bright, forceful record-
ely adequate to the occasion.

Mantovani has no idea at all of
espect to the music. He makes
es just material for exaggerated
s and cafe showmanship which
nt quite out of place. Equally
lace is the fine work of Katchen
nt to hear but musically quite

Perhaps you'll be less critical
m.

**CHMANINOFF: Concerto No.
) Minor, Opus 30. Played by
zynski and the Philharmonia
stra conducted by Paul
i. Columbia 33CX1161.**

disappointed with this record.
ng by the difficulty we have in
really good performances of
hinoff, one can only conclude
isn't as easy to play as would
ined.

ic that's true. I've recently heard
Rachmaninoff concerts in Lon-
I can't say that any of them
me any better than do the cur-
of recordings.

is something subtle in the music
eems to elude even the best
Or can it be that they don't try
ough? Horowitz does very well
No. 3, but he betrays himself
lling for the temptation to in-
inappropriate keyboard holi-

earest to my ideas of perfec-
Kapell's last concert in Aus-
which he played this concerto.
ely I taped portion of it, and
efore refresh my recollection at

HOPIN

ls latest issue, Malcuzynski can
ade himself that the score isn't
in. Occasionally he does throw
Polish complex, but even then
ther an effeminate, over-senti-
Rachmaninoff which emerges.

ust can't reach the full size of
concerto if you play it that way.
loes the recording help things

o-to-orchestra balance is extremely
modern standards. It seems
that someone could have been
ess with a potentially fine line-
lis. Even the tape-joins are at
dly managed, particularly one at
nencement of a cadenza near the
e last movement. Here it sounds
h the piano by some magic has
denly shoved 20 feet back from
rophone. Things like this just
happen if we are to treat a record

e, I'm afraid it was just another
ance.

BRAHMS: Concerto No. 1 in D Minor, Opus 15. Played by Malcuzynski and the Philharmonia Orchestra, conducted by Paul Kletski. Columbia 330CX1048.

This is one of the hardest piano concertos to play. It is difficult enough in a concert hall, where size and atmosphere help hold it together. Under the microphone it is almost impossible to provide at all times that balance and cohesion which Brahms was obviously striving for, but which, I fear, eluded him in many places.

Only by the finest combination of vigor, drive and pianistic stature can that first movement sound convincing.

It can be done. The last time I heard this concerto was in the London Festival Hall with Solomon and the Vienna Philharmonic Orchestra, and they made it a tremendous and majestic thing.

If you are looking for this kind of performance, then this disc will not satisfy you. Malcuzynski plays quite charmingly at times, and produces an appropriately beguiling second movement, but he just isn't up to the pressure required in those titanic climaxes which, in fact, only the titans can play as they should be played.

It scores well, however, in its general sound. Both the piano and the orchestra are firm and clear. In this respect it is probably better than either Wuhrer for Vox or Backhaus for Decca, although both these men give a much stronger and more classical performance.

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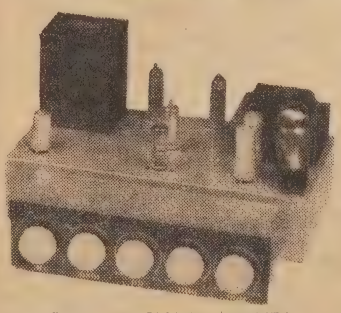

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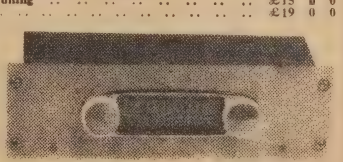

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SHORT-WAVE NOTES BY ART CUSHE

NEW STATIONS IN THE AMERICAS

Many new stations in the Americas are featured this month, together with the complete schedules of the stations in Venezuela and Colombia.

PERU

REPORTED last issue, Radio American at Lima is using the callsign OBX4U on 3240 Kc reports the World Radio Handbook, which gives the power at 5000 watts. We still hear this station to closing at 3.30 pm. Other new stations are OAX4K, Radio Selecto, Lima, 9585 Kc, 300 W; OCX4B, Radio el Pueblo, Lima, on 4860 Kc, 300 watts; OAX2G, Radio Cajamarco, located at Cajamarca, uses 4770 Kc with 500 watts; OAX1M, Radio Pragresso, Piura, on 3330 Kc, 500 watts; while Radio America uses three shortwave transmitters OBX4U (3240), OAX4V (6000) and OAX4W (9360).

GUATEMALA

New stations in this country include the new TGZB using 3355 Kc with only 90 watts, which has been heard here to sign off at 4 pm. The other new station of this new Radio Programas de Guatemala network is TGZA using 6160 Kc with 250 W. Radio Victoria, Mezatenango, uses 4990 Kc with the call TGLAB, and the power 20 watts, and 5970 Kc, TGLA with the power of 100 watts. Radio Centero, Musical Guatemala, operates on 6050 Kc. Call letters and power are not known. The station formerly on 6160 Kc, Radio Oriental, Zacapa, is now off the air.

ECUADOR

New stations in this country are: HC3RM, Radio Cultural Machala, operating on 4845 Kc with 250 watts; HC4JB, Ondas Manabitas, Sucre, on 3385 Kc power 250 watts; HJ5MH, Radio Amazonas, Cuenca, is using 250 watts on 4850 Kc; HC5TO, La Vos de Pueblo, Riomamba, is on 6025 Kc with 250 watts; HC5JC, La Vos de Salcedo, Saledo, is on 3380 Kc with 200 watts; a further two Guayaquol stations are again operating on shortwave, R. El Telegrafo HC2ET, on 4825 with 250 watts and R. Cenit, HC2DC, on 6150 Kc with 250 watts.

BOLIVIAN station CFS Radio Illimiani, La Paz using 9555 Kc has been opening at 9.00 pm. This station has been heard by Stuart Morris, of Ashburton, Vic. Signals are poor and the station has a program of chimes when opening. Music is fair but the announcements are hard to identify. Roger Legge, of McLean, Va., USA, reports that signals in his area are fair when the station opens. Signals also suffer from interference in this area from the jamming which is directed on the Voice of the United Nations Command, using 9560 Kc

World Listener Rankings

THE ranking of the leading shortwave listeners of the world has been announced by the Deutche Welle DX Session of the German Radio at Cologne. Judged on the number of countries verified basis, the placings show your Short Wave Correspondent in the lead. Placings are:—

1st: Arthur Cushen, Invercargill, N countries.
2nd: Sydney Pearce, Berkhamstead, 140 conturies.
3rd: Roger Legge, McLean, Va., US countries.
4th: Dean Reibold, Maine. Germa countries.
5th: Fritz Buttner, Germany, 106 cou

Radio Australia Adds

A NEW callsign, VLD, will shortly b to the Radio Australia network this 50,000 watter commences operatin Shepparton. The new transmitter is to be in service for the Olympic Gam will commence regular service early. Shepparton is the location of VLA a the two 100,000 watt transmitters. an the 50,000 watt station, while the VLC is located at a position nearer to Me Lyndhurst.

Notes should be sent to Ar Cushen, 212 Earn Street, Inv cargill, NZ. All times used Australian Eastern Time

Flashes from Everywhere

SURAKARTA has been noted on a new frequency in the 60 metre band, from opening at 7.30 pm, and at excellent strength, suggesting that one of the new Radio Republic Indonesian transmitters has been installed here. News in Indonesian is noted at 9.30 pm and again at 1.00 am, the station closing at 1.30 am. Present frequencies for the stations in Surakarta are, YDG, (3305), 10,000 watts; YDG2 (2440), 1000 watts; and YDG3 (7250), 1000 watts. The station has been heard also in Cyprus, where it was thought that the Ambon station was heard at 5.00 am in the transmission change, but our observations show it Surakarta on this frequency.

DEUTCHE WELLE'S transmissions in metre band, are the subject of comme one of our readers, Ronald Pearson, Sev NSW, who reports good signals at 5.00 station was heard at 5.00 am in the tra to Africa, and on 17,815 Kc. The pr was news in English at good strength, is followed by the French transmi 5.15 am. Budapest has also been the same hour, on 9835 Kc with a pr in English, and at 6.00 am a program w in Spanish, with English again at 6.30 very good strength.

TAIWAN Forces station of the Assistance Group of the US Forces BEC27, verifies reports with a new card readers, including Stuart Morris, rep receipt of one of these. The card is blue and green, showing a map of with radio signals radiating from Taipeh details across the top show the st affiliated with the AMRTVN and that quencies, 560 and 7200 Kc are in use fication signer is Joe Brooks, Program and the station's address is Radio BEC27, Taiwan Base Command, APO Francisco, California. Station is heard at 9.00 pm on 7200 Kc and in verifications have been up to 18 m coming to hand, but a much faster s assured.

FRENCH CAMEROONS has a new st 9900 Kc, Radio Garoua, and is on 4.00 to 5.00 am. News in French is at 4.00 am. Reports to be sent to diffusion du Cameroun, Yaound, Camer

KENYA'S Africa Broadcasting Service Nairobi, ZHW2, 4934 Kc; Mombasa, 4923 Kc; ZHW4, 7172 Kc; Kishumu, 4943 Kc; ZHW23, 7288; Nyerl, ZHW The Nairobi service operates weekda 2.30 pm, 11.45 pm-4.10 am, Sunda 8.30 pm and 1.00 am-4.15 am (Mon

MOZAMBIQUE'S CR7BE using 11 has been heard at good strength from This frequency replaces the 15.082 Kc we reported recently. The same sch carried on CR7BE, 3.00-4.00 pm on and from 4.00 pm on Sunday. gram is in Portuguese and there is s interference from the Prague station o Kc.

BRAZIL'S Radio Central, using has been heard in New Zealand fr on at 8.00 pm. The same hour fin using 3895 Kc opening transmissio at 6.45 pm the Radio Banderantes. S station on 6185 Kc takes the air.

BELGIAN CONGO'S latest sta Station UFAC, and has been widely broadcasting as follows. 3.30-5.30 a except Monday, on 4980 Kc; Sunday pm, on 7156 Kc and 2.00-5.30 am M 4980 Kc. Power is 3000 watts. Tuesday, Wednesday, Friday, Saturday 3.30-5.30 am, and Sunday 8.00-11.00 dress is Radio Diffusion UFAC, 40-45 Elizabethville.

COLOMBIAN SCHEDULES

A COMPLETE list of schedules of the Colombian stations which are being well received at 9.30 p.m., has been released in a World Radio Handbook bulletin, and we pass this on, as it will be of help to listeners interested in this field of DX.

KCs	CALL	SCHEDULE
3250	HJGO	8.50 pm-noon.
4755	HJCJ	10.00 pm-noon.
4765	HJEF	8.45 pm-3.00 pm.
4815	HJBB	9.00 pm-2.00 pm.
4825	HJHC	10.00 pm-2.00 pm.
4835	HJKE	11.00 pm-2.00 pm.
4845	HJGF	9.00 pm-2.00 pm.
4855	HJFV	10.00 pm-2.00 pm.
4865	HJFA	10.30 pm-2.00 pm.
4898	HJAG	9.30 pm-2.00 pm .
4935	HJFR	9.00 pm-2.00pm.
4945	HJCW	9.00 pm-3.00 pm.
4965	HJAE	9.00 pm-3.00 pm.
5015	HJCQ	10.00 pm-3.00 pm.
5020	HJFW	10.00 pm-2.00 pm.
5055	HJDW	9.50 pm-2.00 pm.
5075	HJGC	8.50 pm-noon.
5960	HJCF	8.00 pm-2.00 pm.
6020	HJCX	10.00 pm-2.30 pm.
6040	HJLB	10.00 pm-2.00 pm.
6054	HJEX	9.30 pm-2.30 pm.
6155	HJTC	3.00 am-2.00 pm.
6185	HJCT	10.00 pm-3.00 pm.
6195	HJEZ	9.30 pm-2.00 pm.

VENEZUELA

SEVERAL frequency changes have taken place in this country, so that this list of the new frequencies and schedules will enable the stations to be heard. Reception at the present is good in the 60 metre band, when many open at 8.30 p.m.

KCs	CALL	SCHEDULE
2360	YVQG	8.30 pm-12.30 pm.
2440	YVLG	8.30 pm-1.30 pm.
2480	YVMK	8.30 pm-1.30 pm.
3245	YVKT	9.30 pm-2.30 pm.
3255	YVQL	9.30 pm-1.30 pm.
3265	YVOC	8.30 pm-1.30 pm.
3275	YVMC	8.30 pm-1.30 pm.
3285	YVLE	9.30 pm-1.30 pm.
3295	YVOG	8.00 am-12.30 pm.
3305	YVKX	8.30 pm-1.30 pm.
3315	YVKI	9.30 pm-1.30 pm.
3325	YVRA	9.30 pm-12.30 p.m
3340	YVMU	8.30 pm-12.30 pm.
3345	YVKP	8.30 pm-1.30 pm.
3355	YVLD	8.30 pm-1.30 pm.
3375	YVMI	9.30 pm-12.30 pm.
3385	YVQI	9.30 pm-12.30 pm.
3395	YVOK	9.30 pm-12.30 pm.
4760	YVKV	8.30 pm-1.30 pm.
4770	YVMW	9.30 pm-1.20 pm.
4780	YVLA	9.00 pm-1.30 pm.
4790	YVQN	8.30 pm-1.20 pm.
4800	YVME	8.30 pm-1.30 pm.
4810	YVMG	8.30 pm-1.30 pm.
4820	YVNB	9.00 pm-12.30 pm.
4830	YVOA	8.30 pm-1.30 pm.
4840	YVOI	9.30 pm-1.30 pm.
4850	YVMS	8.30 pm-12.30 pm.
4870	YVPA	8.30 pm-1.30 pm.
4880	YVKF	8.30 pm-1.30 pm.
4890	YVKB	8.30 pm-1.30 pm.
4900	YVQE	8.30 pm-1.30 pm.
4920	YVKR	8.30 pm-1.30 pm.
4940	YVMO	8.30 pm-1.30 pm.
4950	YVMM	8.30 pm-1.30 pm.
4960	YVQA	8.30 pm-1.30 pm.
4970	YVLK	8.30 pm-1.30 pm.
4990	YVMQ	8.30 pm-1.30 pm.
5030	YVKM	8.30 pm-2.30 pm.
5040	YVMA	8.30 pm-1.30 pm.
5050	YVKD	8.30 pm-1.30 pm.
6170	YVKO	1.00 am-1.30 pm.
9510	YVXK	8.30 pm-7.30 am.
9550	YVMZ	8.30 pm-7.30 am.
9570	YVOM	8.30 pm-1.30 pm.
9640	YVSC	1.00 am-1.30 pm.

HE HAM BANDS WITH BILL MOORE

Contests for Radio Amateurs are popular in the spring and details of three such events listed below. One additional contest is the European DX test conducted during November.

itirely new Telephony DX contest has n arranged by the RSGB and will be d during November on the 21 and ands.

aimed to encourage stations to operate bands during the years of high sun- vity. Running for a straight 36 hours, in the UK will work the rest of the It is suggested that participants should RSGB".

ules are as follows:—

e contest is open to licenced amateurs part of the world.

e contest is divided into two sections. a) low power—maximum input 25 watts, power—maximum licenced power.

e contest (both sections) will start at T on Saturday, Nov. 24, and end at T on Sunday, November 25, 1956.

y type of telephony transmission for he station is licenced may be used. , NBFM, SSB, &c.

ly the entrant will be permitted to the station for the duration of the

ries must be set out as shown in the below, using one side of the paper Entries must be postmarked not later cember 10, 1956, and addressed to ontests Committee, New Ruskin House, ittle Russell St., London, WC1. The late for acceptance of entries is Janu 1957.

trants must operate within the terms licences.

w one contact per band with each ill count for points, but duplicate con- uld be logged. Cross-band contacts allowed

SEAS STATIONS

erseas stations may only claim points acts with British Isles stations (G, GC, GM, GW). British Isles stations work each other for points.

r each completed contact British Isles will score five points. In addition, of 20 points may be claimed for the tact with each new country on each For the purpose of this rule the official list will apply, with the exception VK, W, ZS and ZL call areas will ant as a separate country. Overseas will score 5 points for each completed with a British Isles station.

dition, a bonus of 50 points may be for the first contact with each British ntry numerical prefix, e.g. G2—, G3— W2—, GM3—, G15—, &c.

erial numbers must be exchanged and dged before points may be claimed al number of 5 figures consists of the ort plus 3 figures which may start number between 001 and 100 for the tact and increase by one for each

Metcalfe Trophy will be awarded to ng station in the lower power section British Isles.

Whitworth Trophy will be awarded to ing British Isles station in the high ection. In addition, certificates will ded to the leading station in each n each of the other five British Isles refix zones and also to the runners e trophy winners' zones.

ates will also be awarded to the station in each overseas country VE- ZL and ZS call areas counting as in Rule 10.

should show details of the equipment section entered.

must show in the following order: date ct, band, time GMT, call sign, report t out, points claimed, bonus points and a blank column for checking laration should also be enclosed certify power used, and the fact that the imitations have been observed.

THE CQ CONTEST

CQ Magazine's World Wide DX Contest be held as usual in October. There changes in the rules, no major varia- nd stations in the world's 40 zones ne another.

erial numbers to be exchanged include report and the zone in which the s located for CW and RS plus zone for telephony.

Zones for Australian and New Zealand stations are as follows:—ZL—Zone 32, VK2, 3, 4, 5 and 7—zone 30, VK6 and Northern Territory —zone 29.

This year a special cup will be awarded to the single operator station on both phone and CW recording the highest score.

The phone section of the contest commences at 0200 GMT on October 20 and concludes at 0200 GMT on October 22. CW section commences at the same time on October 27 and concludes 0200 GMT October 29.

Operation is permitted on all bands 1.5 through 28 mc/s and for the first occasion includes the 27 mc/s band.

Single and multiple operation of stations is permitted on both phone and CW and a special novice section is being incorporated.

Awards are to be made to the highest scorer in each zone. A special plaque will be awarded to the Radio Club whose members tally the highest total score.

VK-ZL CONTEST

THE 1956 VK—ZL DX contest will be conducted by the New Zealand National Society, the NZART.

The telephony section will commence at 1000 GMT, October 6, and conclude at 1000 GMT, October 7. The CW sections runs one week later between the same times on October 13 and 14.

The same rules apply as for the 1955 contest, several numbers comprise RST and several numbers of contact for CW and RS report and serial number for telephony.

A separate log should be submitted for each band and be forwarded to the NZART, Box 489, Wellington, New Zealand.

RF SOURCES

THE FCC has recently promulgated new regulations in relation to "Incidental and Restricted Radiation Devices", covering nearly every gadget which generates radio frequency energy with no intention to radiate it.

The purpose is to control unwanted radiation from such devices that might interfere with other radio services.

"Incidental" radiation devices include heating pads, vapor lamps, power lines, electric motors, while the "restricted" field includes wireless record players, HF oscillators in TV receivers, &c.

Harmful interference is defined by the FCC as "any radiation or induction which endangers the functioning of a radio navigation service or of a safety service, or obstructs, or repeatedly interrupts, a radio service operating in accordance with the regulations".

It was pointed out by the FCC that if every user of a radio service experiencing such interference were to call on the authority for assistance, the staff would be unable to cope with such numerous requests.

The commission will look upon the radio services, including amateurs, to attempt to correct such interference and the FCC will not act unless it is particularly severe.

The FCC hopes that the industry will act and reduce the possibility of interference being caused by equipment manufactured in the future.

GOVERNMENT AID

IT is interesting to note that in the US, the Radio Amateur Civil Emergency Service (RACES), under certain circumstances, is assisted financially by the Federal Government to acquire suitable equipment for net operation.

In many cases initial finance is made available by local government authorities when the value of RACES operation is fully publicised.

The Federal Government then provides a matching rebate of approximately half of the initial outlay.

Commercial equipment is generally obtained and the cost of this gear for a town of 20,000 population would be around 3500 dollars.

At times the whole of the net transmitters and receivers have been home constructed but, to obtain Federal assistance, this gear must be of commercial origin and meet certain government specifications.

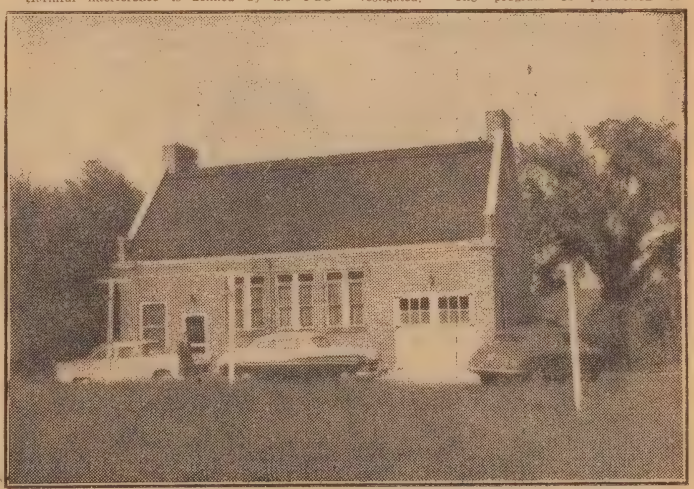
ARRL DECISIONS

DECISION reached at the 1956 board meeting of the ARRL are mainly directed toward improved operating conditions in the US.

One such subject could affect international working on amateur bands and that will be a request to the FCC for the extension of the 14 Mc telephony band by 50 Kc/s, to read 14,200 to 14,350 Kc/s.

The desirability of an exclusive CW allocaholders of advanced (class A) and amateur extra class licences. Other decisions include an approach for radio-teleprinter privileges in the 1800-2000 Kc/s band.

The desirability of an exclusive CW allocation in the 144 Mc/s band is also to be investigated. The program of promotion of



A rear view of W1AW, the official station of the ARRL in West Hartford, snapped by the Editor on his recent visit. W1AW is the memorial station to Hiram P. Maxim, co-founder of QST and first President of the ARRL.

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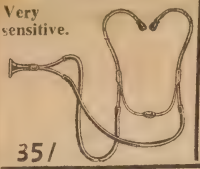

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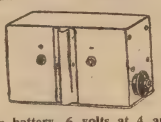
Fitted with Brand New English Selenium Rectifier.



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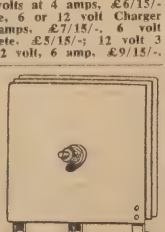

Transformers to suit above, 2 amps, 39/6; 6 volt, 5 amps, 45/-; 12 volt, 5 amps, 55/-; Transformer to suit dual charger, 6 and 12 volt, 39/6. Rectifier to suit, 45/-.

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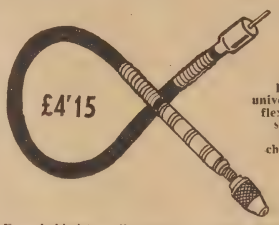

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Eng. 0-200 Ammeters, M Coil	£4/10/-
Eng. 20-0-20 Ammeters, M/coil	37/6
Eng. 0-50 Amps AC-DC 3¾in dial	75/-
Eng. 0-80 Amps AC-DC, 3¾in dial	75/-
Eng. 0-1 Amps DC 2¼in dial	35/-
Eng. 200 Amps AC-DC 3¼in	£4/19/6
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Eng. 0-6 Amps 3¾in DC	25/-
Eng. 0-25 Volts 2¼in DC	22/6
Eng. Ohmmeter reads 0-60 M.Amps 0-500 ohms, 0-15 volts, 0-3 volts 3in dial.	45/-
0-100 milliamps, new	17/6
4 x 4½ 0/1 Milliamp Meter	£5/5/-. Also 0/100 Microamp, £6/6/-.

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20 Magnifications
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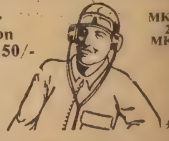

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English Motor and Blower, 24 volts. Will work off any Lighting Plant.

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Large size also available that work off 12 or 24 volts, £3/

BRAND NEW LEVER TYP GREASE GUNS WORTH £4/

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Ideal for all types of Trucks Tractors or Cars, 7500lb pressu

in the VHF and UHF bands is to rued and expanded.

eneral manager reported on the pro- ateur participation in the International al Year program, particularly with o propagation study and satellite track-

ARRL NOTES

G July over 2000 amateurs gathered ther in San Francisco for the ARRL onal Convention under the chairmanship Bane, W6WB. It was the largest of amateurs yet held on the west

gan for the convention was "Some- Everybody" and manufacturers through- country exhibited equipment suitable eur use.

were wide and varied from an an- osium to a presentation covering re- flections on DX transmissions. specialists in attendance included Ed VIHDQ, Frank Jones, W6AJF, and mith, W6BCX.

and IARU secretary, Mr. A. Budlong, reported over the Voice of America Radio Broadcast on his visit to the taly, convention of Region 1 IARU

ntatives from all European national were in attendance, plus observers e African bodies.

phasised the tremendous enthusiasm all present in their work for amateur d recorded his personal thanks to .B., R.E.F. (French), A.R.I. (Italian) or the hospitality extended to him.

radio activity in Australia is receiv- publicity over the Voice of America . Recently the rules for the 1956 X contest were covered and opera- CIACA from the Albert Hall, Canberra

broadcasts are heard very well on etre band from Tangier at 0745 EAST day. Tangier runs 1-million watts with the many buzz signals heard international SW broadcast bands.

BEAM CHANGES

BER of amateurs have in recent months d their beam arrangements to pro- imum front to back discrimination rather than just maximum forward

ve found that with the arrival of ot maxima, and signals arriving at good strength from all directions, QRM has become increasingly difficult on the HF bands and the beam variation assists in sorting the varied stations.

In the seventeen years since its inception the YL Radio League membership has risen to 600 members. Elsie, W3MSU, and Carol, W6WSV, were the foundation members and met recently for the first time.

Previously all their contacts had been via amateur radio or letter. They estimate there are approximately 3000 YL operators throughout the world.

Until October 31, CR7BM, station of the National Society in Mozambique, will be active on all bands and will provide special QSL cards for all contacts. They will commemorate the visit of the President of Portugal to the colony.

WIA NOTES

THE Dural VK2WI project of the NSW Division is progressing satisfactorily with over £800 subscribed. Early in August the foundations of the building were placed after a volunteer party had excavated the necessary earth.

Substantial progress should be made on the building during the next three months. At the initial "sod-turning" party amateurs in attendance included VK2AET, 2AAJ, 2RU, 2AAT, 2AAB, 2AUM, 2VC, 2EN, 2YC, 2EO plus associate Les Adams and many XYL's, YL's and junior operators.

Plenty of assistance from members is required to complete the building, working parties are held each Sunday at the site, Quarry Rd., Dural. State president, Jim Corbin, VK2YC, MU1092, would be pleased to hear from any prospective helpers.

VK2WI Sunday broadcasts are being conducted from Dural, where an AC operated AR2B is installed in Ed Hulme's VK2EN caravan left permanently on the site.

Recent visitor to Sydney was Dr. Ian Morrison, VK4MO, who was given full details of the VK2WI Emergency Net Operation and general organisation. He spent much time in session with Jim Corbin, VK2YC, moving force behind NSW emergency working.

VK4MO is a member of the VK4 emergency committee which operates under the chairmanship of Vince Jeffs, VK4VJ.

In VK4 they are organising their net along similar lines to that operating in NSW. Ian then travelled across to VK5 and further discussions on emergency work were held. Bob Gurr, VK5RG, is in charge of this work in South Australia.

It is anticipated that these discussions will prove invaluable in providing a common operating basis for all three States during emergencies.

These States have a common problem in some cases as rivers rising in Queensland find their way to the sea in South Australia.

At the July meeting of the SWL section of the VK5 division WIA members discussed the rules of the Remembrance Day contest and intimated they would be active in the listener's section.

A visit to BIC station 5KA was made at the completion of the meeting and the group thanks Mr. Bob Patton and Len Cragen for making the inspection possible.

Members spend much time listening on 144

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l pickup and arm with match. trans. ("Shelf") 25/-
New, ex-RAF. 0-20 volt, 5 ma movement 19/6

Variable condensers, AWA Single gang 425pf (Xtal sets, etc.) 14/9
Magnavox 8in Permag speakers with trans. (8P2) 37/-
Army Phones, new, low imp., suit crystal sets, etc. 25/-
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4A42 Germanium Diodes. Best for crystal sets 10/-
Egg Insulators, porcelain .. .. Per dozen 6/-
Dr. Cecil Crystal and detector for crystal sets 2/-
ABAC 6v-150v-60mA Vibrator Transformers 15/-
Electric jug spirals (nichrome), 230.v 1000 watts .. .. .. Per dozen 10/-
Volume controls, midget, ¼ meg 2/6
Volume controls, Egan, ½ meg. 3/-
Volume controls with switch, ½ meg. 5/-
Valvet sockets, bakelite wafer, 4, 5 7 pin. Mixed or one type.
Per dozen 3/
Shield cans, shaped "Goat" brand (valve) .. .. Per dozen 6/-
Battery valves, 2 volt triodes, 1F5G 5/-
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For quickest possible service, write on the left-hand side of a sheet of paper the radio parts that interest you — one beneath the other. If a kit, itemise. Add your name and address and send it to us with a stamped, self-addressed envelope. We will add the latest prices and return to you. Use this sheet as your order form and return to us with remittance for cost and postage as quoted. Goods will be sent same day. Any surplus refunded. Sorry, no C.O.D.

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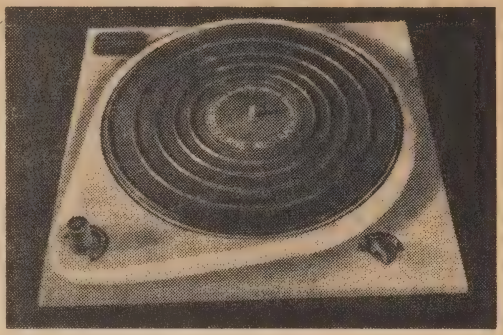

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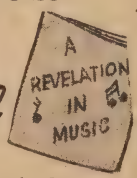

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Get this fact-packed book. It tells how you can be playing in 30 minutes and all popular tunes in a few weeks — how to learn at home without visits to a teacher, and how to banish nervousness and play at parties—evenings. But post this coupon today—there are only 1000. Don't delay. Enclose 3½d postage stamp and mention the instrument you favour.

Mc/s and Bob Godsall, VK2ARG/M in and around Adelaide created co interest.

The group meets third Monday at th Methodist Mission, Franklin St., Adel

SW CONVENTION

THE Fourth Amateur Radio Conve the South-Western Zone of the NS sion will be held at Griffith over the Day weekend. An extensive program terest to all has been arranged and the convention will be at the 100 Banna Av., Griffith.

Visitors will be welcome and Stuart VK2PL, Box 631, P.O. Griffiths, or zon Jim Edge, VK2AJO, Coolamon, will be to supply any details required.

Registrations will be taken from 10 2 pm on Saturday, September 29.

A tour will be conducted from 2 pm, afternoon tea 3.30 to 4 p.m., offic address from 4 pm onward. During t ing a dinner and social evening will

The field events are scheduled for commencing with a scramble from 9 10.30 am (operation from AC mains mitted, 11 am till 12 noon 144 Mc transmitter hunt.

During the afternoon disposals, lucky with a blindfold transmitter search featured.

The official prize presentation will at 4 pm.

Amateurs in the south-western zone pleased to see as many visitors as and assure they will be entertaind in t Ham fashion.

The second event to be conduct the Six-Hour Day weekend in NSW WIA's Hunter Branch fifth annual Park outing. Commencing at 3.30 pm it will conclude at 5 pm Sunday.

A full program has been arranged and XYL's, accommodation is availab

Visitors will be very welcome, ful of the event can be obtained from any Hunter Branch members, direct or air.

Lecturer at the August meeting of t VHF section was Max Sobels, VK2 subject "Sweep Generators".

The lecture was fully illustrated demonstrations including the visual a of BC and TV sets and the selectivit of a communications receiver with a out crystal filter.

Another new departure in 144 M Hunts" was conducted by the NSW VHF section on August 5. On this the "Fox" transmitted from eight in country areas around Sydney.

Each transmission consisted of nine tone and one minute on voice, the period for taking bearings while dur voice period a specific bearing to so known point was provided.

This latter information, together wit ing taken on the "Fox", allowed the to pinpoint the location of each tran

The "Fox" left at each location a clue and if found by the "Hounds gained special points award.

At the end of the eight transmissi "Fox" retired to Parramatta Park and final half hour broadcast. Ray VK2YM, was first to locate the "Fox Miller, VK2ANF, second, and Cec Thor VK2AZO, third.

FINAL PLACINGS

The final placings after points were for clue finding were John Miller, V first, Ray Hancock, VK2YM, second, Lapthorne, VK2HL, third.

Cryptic clues included a cascode drawn on the side of a waiting shed, carton on a post, a 288 Mc/s beam fi a fence, and a germanium crystal from a wire. Bob Winch, VK2OA, the part of the "Fox".

The section's mid-winter 144 Mc con over two evenings in July was well s and competitors were kept busy handli sages. At this stage logs are still checked.

One message travelled over 300 mil Tumut to Forbes and via a varied Sydney.

21 Mc IF's in TV receivers were t ject of much Press and radio comment July. The Postmaster General's annou clarified the position, as did the state the Federal Executive of the WIA.

It would appear that where TV do not conform with the Australian casting Commission's board recomme for IF frequencies and where such suffer interference from the various ra vices, the responsibility for the correc the problem will rest with the TV se

Undoubtedly much more will be heard aspect of TV in the future.

RADE REVIEWS AND RELEASES

PREMISES UNITED RADIO

D Radio Distributors Pty. have announced an extension ses to cope with the increased n radio, high fidelity and elec- uipment.

tensions consist of 5000 square warehouse space in a central he city. The showrooms and lelivery section will remain at ip St.

f the new premises is to be television receiver installation ce.

orders should be addressed to 5, G.P.O., Sydney. Telegrams Sydney. The telephone num- for counter sales, BL3954 for orders, BU7321 (3 lines).

CAPACITORS FOR TV RECEIVERS

United Capacitor Co. Pty. Ltd., of 433 Punchbowl Rd., Enfield, NSW have submitted for review, a new range of "Superseal" type PPS Tubular Capacitors. These have been developed to meet the stringent requirements of TV manufacture.

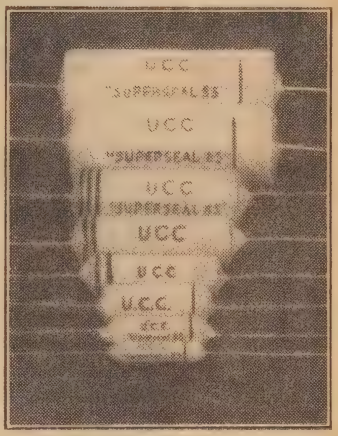
THIS new range of capacitors is intended to replace the older wax-protected types, which are limited to an operating temperature of 60 degrees Centigrade.

In the new superseal range, the wax seal is replaced by an entirely new sealing medium, in the form of a special thermo-setting polyester resin. This provides an efficient seal and allows a working temperature of 85 degrees Centigrade to be reached.

A further advantage is that flexing of the pigtail leads no longer tends to break the seal or connection with the internal foil.

Pigtails are soft-solder coated copper wires, which are firmly attached to the ends of the winding. The ends of the protective tube are spun over to ensure a complete seal between the end filling and the capacitor body.

The completed capacitor is then given a coating of a high melting-point compound and is individually tested for breakdowns, insulation resistance and capacity tolerance.



Type PPS Superseal capacitors are thus doubly impregnated to ensure complete removal of voids and moisture. This is aimed at preventing localised dielectric stress and consequent breakdown due to ionisation.

They are protected mechanically by the multi-layer paper wrapping applied directly over the capacitor winding.

UCC's color code for the printing on the capacitor body, indicating the maximum DC working voltage, has been retained. The code is as follows: 200 volt—Black; 400 volt—Blue; 600 volt—Red; 1000 volt—Orange; 1500 volt—Light Blue; 2000 volt—Heliotrope.

w Twin Speaker from MSP

nce of considerable thought in design is shown in the MSP wide-range speaker which is now available.

two-unit design, consisting of in main cone with a novel of bracing to avoid break-up, ndividual tweeter which comes ut 3.5 Kc.

acing for the main cone uses uminium beams glued to it. ing between the beams, and es as related to the radius are al to conform with calculated s, so that no cumulative reson- cts are possible.

The suspension ring is treated with rubber damping sections, also of uneven dimensions, with the same end in view. The radial and circumferential stiffening thus obtained is claimed to raise considerably the power handling of the cone before breakup is noticed.

An extended voice coil is fitted to allow considerable cone excursion with improved linearity.

The tweeter is mounted slightly out of centre with the main cone to avoid equal reflection paths from it. It has a top range of 12 Kc before a fairly sharp attenuation is reached.

The rated power handling of the assembly is 20 watts.

On test the speaker gave clean reproduction with good bass when appropriately loaded. A general rise at about 3-4 Kc produced good presence, although a second rise at about 8 Kc might respond to a little suppression if you are extremely critical.

At a retail price of £17/12/6 this speaker is most promising. Its main resonance is nominally 45 cycles, and voice coil impedance 12-16 ohms.

Acoustic efficiency is not equal to more elaborate types, but similar to that of other designs of comparable price. There is, however, likely to be adequate reserve power in the type of amplifier used with it.

Special designs for speaker enclosures will be produced by MSP. Good baffling is quite essential for a speaker of this type and if the space is available, a sturdy vented enclosure of up to eight cubic feet would be preferred.

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...proved outstanding in performance and reliability

Throughout the Army . . . the Navy . . . and the Air Force, S.T.C. Brimar valves are fighting the toughest conditions possible and maintaining an amazing performance of stamina and ruggedness! Whenever the going is really tough, S.T.C. Brimar valves are giving a type of reliability that leaves other valves way behind.

That's why S.T.C. Brimar valves are fitted to radio communication equipment and navigational and air navigational devices throughout the world. In your own radio work too, S.T.C. Brimar valves will give you top-line performance and the highest degree of reliability. Specify S.T.C. Brimar valves for all your valve needs.

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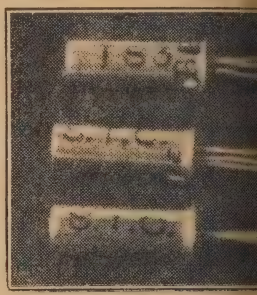
FI33

NEW TRANSISTO FROM STC

A group of new compo recently released by S should be of interest to signers of miniaturised e ment, particularly in the field. These are three transistors and a range miniature tantalum electro capacitors.

THE transistors are designed TS1, TS2, and TS3. All are ed primarily for audio applicat feature of these types is the u hermetically sealed metal case w addition to protecting the unit f verse atmospheric conditions, a higher dissipation (50mW) tha otherwise be possible. By clam a metal chassis the rating can further increased by nearly two

For many applications these u replace the earlier "TJ" series although having much bigger di



ratings, were considerably more sive. Where such high ratings essential advantage can be take lower cost of the "TS" series.

Prices are 33/-, 33/-, and 44/- TS1, TS2, and TS3 respectively.

The electrolytic capacitors ar able in a range of sizes and volt being specially suitable for transi cuit applications. The unit ill (compared in size with a sixpe a capacitance of 5 mf at 6 volts. same physical size values range

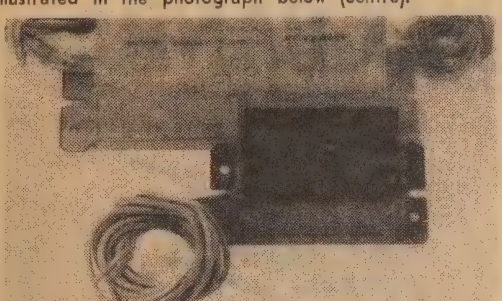
1.5 mfd at 25 volts to 10 mf at

A feature of the tantalum ele is that, unlike the aluminium va produces no gas while in operati a result it can be completely sea is ideally suited to "Potted" cons It also does not "de-form" while storage.

Further details of these com may be obtained direct from S Telephones and Cables Pty. L Botany Rd., Alexandria, Sydne

TIONAL QUICK-START BALLAST

eresting item from the comprehensive range of National in- s for fluorescent lighting is the quick-start transformer type QSA1 illustrated in the photograph below (centre).



nsformer able for either watt or vatt fila- fluores- and pro- tially in- o p e r- ting ser- is re- d con- series lead of mains. r the switch, me item, is eliminated. k-start transformer is actually r with taps a few turns from These small windings are across the fluorescent tube one to each end. ns is applied across the trans- ough the ballast choke. Before trikes virtually the full mains applied across the transformer aments are heated by approx- e same current as with the al starter switch connection. p lights in a small fraction of when the voltage across the r drops to the arc voltage of The filament voltage applied es drops proportionately and, about half the starting value. t that this arrangement pro- immediately is of great value dustrial applications but even the home where the several the usual starter switch ar- can be particularly annoying. p manufacturer has suggested uick-start arrangement actually the life of the tubes by re- number of current surges to filament is subjected. ure reliable operation the tubes should be mounted ch of a metal fitting running of the tube and the fitting earthed. Alternatively, we understand that standard tubes fitted with earth strips will become generally available.

The cost of the quick-start transformer is about the same as that of a fluorescent ballast choke.

National also provide a ballast and quick-start transformer in a single case and fitted with leads long enough to be wired into standard fittings. The 40 watt unit type QS140 is illustrated above but a single 20 watt unit under the type number QS120 is also available. The case may be mounted with two screws only which is a worthwhile advantage for production work.

In the case of the QS140 operating a 40 watt lamp, the lamp current is the full recommended 410 mA while the total current is 420 mA. The total power consumption is 49 watts of which 2 watts are consumed in filament power under operating conditions. However, the total light output is slightly greater than with the usual starter since the full length of the filament is active.

The filament starting voltage is 11.7 volts which drops to 5.3 volts when the tube conducts. The overall power factor may be brought up to 0.85 or better by connecting a 3.5 mfd capacitor across the mains.

Overall dimensions are: length 7in width 2¾in, height 2 1/16 and the weight 3.9lb.

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F1208 has a 240-volt primary volt 20 mA secondary. A nt extension to this winding p a total rms of 1000 volts d for CRT EHT. Filament are 6.3 volts at 3 amps, 6.3 0.6 amps with electrostatic 1 4 volts at 2 amps tapped ts. This type has been avail- able without the copper band for some time under the type number PF545. (Note that the current rating of types PF1208 and PF545 is insufficient for the wideband CRO amplifier described in the August issue.)

Where additional high tension current is required, type PF1208 rated at 325 volts each side of centre tap at 40 mA and fitted with the copper band will be found useful. When the windings are fully loaded the external field is quite small and in any case the use of two separate transformers makes it possible to arrange for their external fields to cancel by suitable phasing.

Type PF1208 is available without the copper band under the type number PF300.

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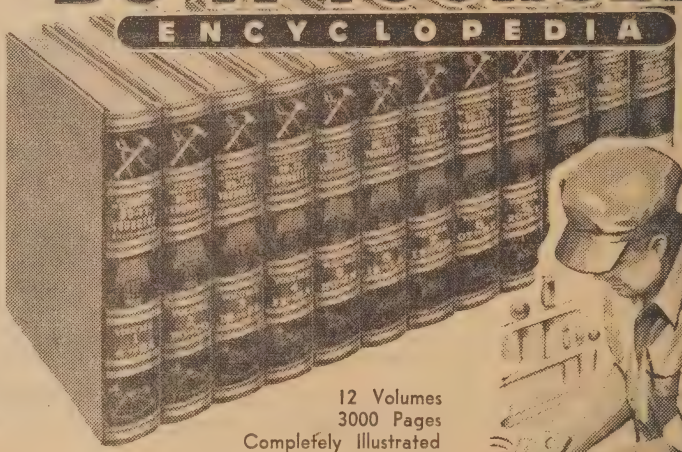

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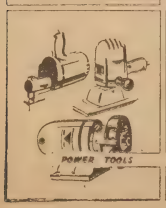

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ILD YOURSELF A TELEPHONE

(Continued from page 43)

lever with a suitable weight. uld be just short of that required ss it and may take the form of ps fastened to lever inside the

witch is mounted against the in- he case on the side opposite that ng the lever slot. An angle will be necessary to support the which is mounted with its wafer angles to the side. It will prob- necessary to trim one corner racket to prevent it fouling the oring. The bracket can be made crap of brass or aluminium.

racket is fastened to the side of by means of two ¾in long 1/8in ntersunk bolts and nuts. Along other countersunk bolts which used, these are disguised on the of the case by covering with wood and sanding smooth.

RY

battery is a standard two-cell, lt cycle type, but could be a 950 type cells connected in series. would take up less space, which e useful if the available buzzer than the one we used. This imported type, from Europe, as a Duro. Considerable space saved by removing the cover buzzer, and which is not really

battery is held against the side case with a simple aluminium d, in the case of the cycle bat- is makes contact with one of ery terminals. The other termin- dered directly to the appropriate

wiring will be a good deal easier re commencing assembly, each ent has attached to it about six f wire from each active terminal

Then, after assembly, the wires may be trimmed and connected to the appropriate parts of the circuit.

A five-tag terminal strip is used to terminate the incoming line, the lead from the handset, and as a junction point for the leads from one terminal of the switch and one terminal of the buzzer.

The push button is a standard item and, ideally, should be white to contrast with the black finish of the stand. If, like us, you cannot get a white one you will have to do what we did, paint it. This is not difficult, but several coats may be necessary and the drying time will be longer, since the bakelite does not absorb any of the paint.

In the final set-up it is essential that the two batteries in the system be correctly polarised relative to each other

While they operate separately as far as the buzzer circuits are concerned they are connected in series for the talking circuit and must be the right way round. The correct polarity is shown in the circuit but, if the two units are wired identically, the polarity can be corrected by transposing one set of connections to the line.

NOT HARMFUL

No harm will be done if the batteries are wrongly connected, but the system will perform very poorly, or possibly not at all, as far as the speech circuit is concerned. In such circumstances it will merely be necessary to reverse the line connections to one unit.

The handset is built around a file or chisel handle which can be purchased for a few pence from any tool or hardware store. It should be at least ¾in overall, probably the largest normally available. It will need to be drilled as shown in the diagram to accommodate the various leads to the transmitter and receiver.

The hole drilled right through the centre may look to be a tall order, but it can be done with a little care. It will need to be done from both ends and you will find centre marks from the lathe which will help considerably. Enlist the aid of your friend to "line up" the drill in the horizontal plane while you drill. You can check it laterally yourself.

One end of the handle is cut out to provide a flat surface (see drawing) and the receiver is mounted against this. It is held in place by means of a 1/8in bolt, about an inch long, which passes right through the handle and the back of the receiver case. To drill the case unscrew the cap, remove the diaphragm and drill from the inside. The hole should be diametrically opposite the terminal position at a spot where there is normally a small number moulded into the case on the inside.

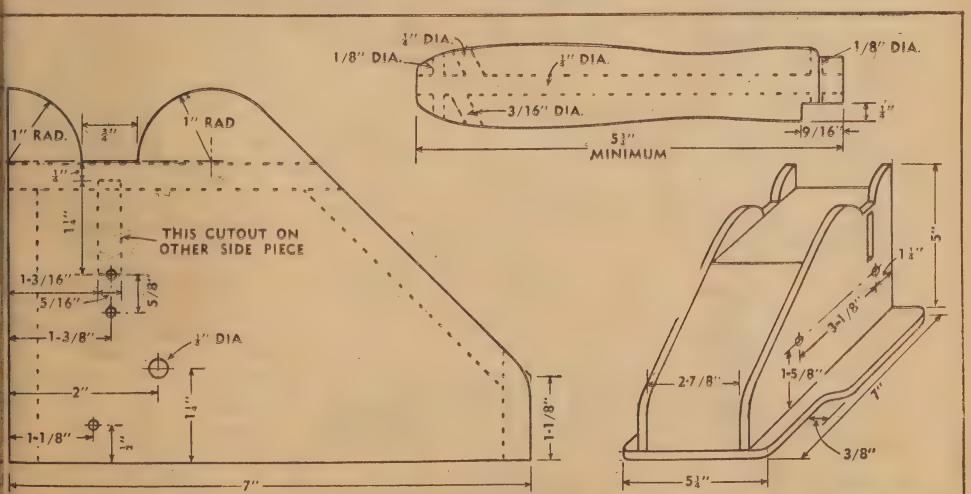
MICROPHONE MOUNTING

To mount the transmitter you will need a 1/8in dia. bolt, 1¼in long. This should first have a nut threaded onto it, then be inserted in the central hole in the rear of the unit and soldered in place. The head is now cut from the opposite end and the nut used to clear the damaged thread. Pass the bolt through the 1/8in hole in the other end of the handle, secure with a nut and washer, and the transmitter is mounted. The rough end of the bolt should be dressed with a file.

The transmitter and receiver are wired in series as shown in the circuit and the polarity of either is not particularly critical. The two terminals on the receiver are obvious, while the two connections to the transmitter are the mounting screw just described and the metal plate at the rear of the main portion.

Although almost any kind of wire will serve to connect the handset to the main unit, this cord must stand up to a lot of bending and ordinary hook-up

(Continued on Page 119)



rawing shows all esential data to allow you to make the stand. Material is ¾in plywood and ordinary cabinet making iques are employed. Note also the details of the handle used to make the handset, particularly the location of the cable holes.

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D TIMEBASE

a series capacitor to give the coverage.
00 pF can be made up of 250 50 pF units in parallel but the tion. in practice, may prove ll. A 3-30 pF trimmer can be n parallel and adjusted for the nge. Finally, there should be culty in getting the required with a stock 25 pF unit and pF trimmer in parallel in the the top range.

standard potentiometers it is to arrange a circuit which will he fine frequency calibrations Both the linear and log pots the high frequency end of the eing crowded when the fre- is increased with clockwise but the linear pot gives slightly er scale.

AL DIODE

ystal diode is used to clamp K6 screen at the potential de- l by the .15 meg and .047 meg divider. This ensures a uni- bright forward trace when the waveform is used for flyback . Any small thermionic diode a similar job.

ronising signals are introduced suppressor grid via a network to give a minimum impedance it .25 meg between suppressor th. When synchronisation is from the output of the CRO amplifier and with the control full on the timebase will lock vide frequency range for a single which is very convenient for types of experimental work.

he other hand with the sync almost off, the timebase can be r frequency measurements with od accuracy.

ED FLYBACK TIME

of the limitations of the simple ransitron circuit of Figure 5 C must charge through R1 dur- flyback time. If the capacitor ected to the plate of the oscil- a cathode follower (which has ow output impedance) the time r the capacitor to charge can be and the high frequency per- e improved to a worthwhile ex-

worth noting, incidentally, that ebase with this arrangement can e to perform quite well at 0.5 required. We feel, however, ere are few tests where this ould be required.

cond reason for including the follower is that it provides a pedance point from which to output. Stray capacitances then s effect on the high frequency ents of the sweep output than e the case if the output were om the plates of the 6BX6.

happens that the output from hode follower in the present ment is about half that required deflection in the case of a ith a 1500 volt supply. By the of an extra stage with a gain d output in reverse phase, the horizontal deflector plate of the ray tube can be made an active with the advantage that distor-

(Continued from page 39)

tion and defocusing due to deflection are reduced.

The second triode section of the 12AU7 can provide the necessary output with some reserve and it is arranged in a circuit to give approx. unity gain. Negative current feedback is present due to the unbypassed cathode resistor and negative voltage feedback due to a resistor between plate and grid circuits.

It is necessary to include a resistor artificially to increase the output impedance of the previous stage so that feedback can readily be applied. The .1 meg resistor between plate and the grid circuit was determined experimentally to give the desired output. If you are working with a cathode-ray tube which requires deflection voltages of either a higher or a lower value, the resistor could be varied to give the desired horizontal deflection.

It is hard to make a case for varying the width of the pattern particularly as this timebase synchronises so easily over the full range and one, two, three or more cycles of the waveform under observation can be displayed at a twist of the frequency controls. On the other hand if you do wish to vary the pattern width a potentiometer in the grid circuit of the 2nd 12AU7 section would probably allow variation over a considerable range. We have not tried this suggestion.

Care has been taken in choosing operating conditions so that the output of the complete timebase is virtually constant over the entire range.

OUTPUT BALANCE

Exact balance is not important. Although it so happened that the output from each terminal worked out to be the same in our case anything up to 50 pc unbalance either way would not be worth worrying about.

The presence of feedback over the phase reversing stage reduces its output impedance and therefore makes it less critical of stray shunt capacitances. At the same time in wiring the timebase every effort should be made to keep strays as low as possible.

(Continued on Page 119)

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ANSWERS TO CORRESPONDENTS

P.H.F (Wingham, NSW) asks for suggestions on converting an unwanted commercial receiver, for use as an amplifier. The power transformer in this set smokes when switched on. He goes on to inquire as to what would be a suitable transformer for replacement and how to go about finding the fault which causes this.

A. The changes you wish to make can be quite easily accomplished. All that is necessary to isolate the front end of your receiver is to disconnect all leads to the two diodes of the second 6N8 valve. If you wish, you may remove the preceding valves and their associate components. The pickup then may be fed into the volume control which, presumably is in the grid circuit of the second 6N8. With regard to the power transformer, it may not be necessary to replace this component, as it may not have been sufficiently damaged to warrant doing so. It could be faulty but there is the alternative possibility of a short in the B-plus line. The fact that an indirectly-heated rectifier is used may be significant. The natural suspects would be the rectifier and the first filter condenser. A short in the latter would almost certainly cause a failure of the transformer. If or rectifying any such faults the transformer is found to be permanently damaged, then a unit with the following specifications should be adequate for replacement. HT. Secondary: 285 volts per side at 50-60 mA. L.T. Secondary: two 6.3-volt windings.

B.B.I. (Brisbane, Qld.) writes to thank us for a previous answer to some queries and offers some suggestions re the design of a tape adaptor to meet his requirements.

A. Many thanks for your suggestion. However, we feel that, due to the special nature of your requirements, and to pressing editorial matters, we could not undertake this project. Nevertheless if you wish to develop this adaptor and submit it to us, we may feature it in the "Reader Built It" section.

K.F. (Mascot, NSW) sends a circuit of a mixer for two carbon microphones and pickup, for publication in the "Reader Built It" feature, and offers various suggestions for its use.

A. Many thanks, K.F., for the circuit and suggestions; we shall retain it, for possible future use in the "Reader Built It" page.

J.R.W. (Glen Innes) submits a few ideas on running an AC set from a 32-volt lighting plant, and asks us to compute the values of the shunt and dropping resistors in the heater network. He is also worried about the extra volts available at charging times, and goes on to ask whether it is possible to connect a pickup into the audio stage.

A. The alterations you suggest are quite in order. A 250-volt 60 mA genemotor should be adequate for your HT requirements. RF interference and HT ripple filtering should be incorporated. The value of the shunt resistor, marked R1 in your diagram, is 175 ohms and rated at 5 watts. The value of the series dropping resistor (R2) is 14 ohms, rated at 5 watts. A pickup may be fed into the volume control, which presumably is in the grid circuit of the first audio valve. However, only high-output crystal pickups would have sufficient output, to produce any worthwhile sound from the speaker. To operate a record player or changer from a 32-volt DC source, it would be necessary to use a 50-cycle vibrator supply or an inverter unit. The power consumption of these units is small, normally from 60 to 80 watts. No damage should result from operating the receiver while the batteries are being charged. A similar problem is encountered in car radios, and we feel sure that the valve heaters should withstand the extra voltage, which is your case is small.

A.G.W. (Eulo, Qld.) sends in an extract from RTV & H, dealing with an overseas design of a pocket-size two-way radio. He also expresses a need for a unit designed on similar lines for use in two-way communication, for stockmen in thick scrub country. He goes on to say that it must have a range to cover approximately a five-mile radius.

A. We have never described a unit to meet your requirements. Indeed, it would be very difficult to suggest a suitable circuit. Distance coverage figures would be difficult to quote. Moreover, the fact that it has to be portable would govern the height and length of the aerial and the size of the batteries, thereby limiting the range. The type of terrain it is to be operated on, would also be a deciding factor. Another point is whether you could obtain permission as a private individual to operate such equipment.

K.F.B. (Adamstown, NSW) writes to say how much he enjoys reading RTV & H, particularly "The Serviceman Who Tells" feature, and suggests that we feature a voltage table, similar to that used in the article on the "Little General for 1956", for all our designs.

A. Many thanks for your appreciative remarks and for your suggestion. We may follow it in cases like the Little General, where specific components have been specified and there is small risk of confusion.

J.B. (Westmead, NSW), following the "Course in Television" series of articles, would like to know if we intend to include a circuit of a TV set that can be built at home or whether we have a suitable circuit in our files.

A. In the May, 1956, issue of the magazine, we published a commercial design of a TV receiver in conjunction with the Course in Television feature. However, as pointed out in the detailed article, it could not be presented for home construction, since the major components required for the building of the receiver, or any of its kind, are not available to amateurs as yet. At the present we are unable to help you or our other readers with a suitable constructional design.

G.A.B., (Elbow Hill, SA), in renewing his subscription, takes the opportunity of making a plea for further information on 32v. battery supply equipment, suitable for operating radio instruments, tape recorders and so on.

A.: Many thanks for the sub. We appreciate the difficulty with test equipment when one is isolated from the usual 50c/s mains supply. Probably the cheapest approach is a vibrator converter, but unfortunately the waveform is often poor and, with standard vibrators, frequency higher than that of usual mains. The amount of power available from a standard vibrator is also seriously limited. We have promise to publish a practical article on the subject in the near future, but you may like to check with some of the disposals firms who occasionally have 28V to 230V 50c/s inverters rated at about 200 w. The waveform from these is usually excellent, and they could be used to operate a standard AC set for example, with a minimum of additional tering. Two 32V receivers have already described in RTV&H, one with the 32V supply directly to the plates and screens of the and the other with a vibratory high supply.

A.H. (Melbourne, Vic.) asks if we have lished anything of a constructional nature an exhaust gas analyser.

A.: Nothing of a constructional nature been published, although possibly there has some mention of these devices. Just moment it is difficult to justify the time effort it would be necessary to expend velop, test the final model and make recommendations as to its use.

R.B. Albury, NSW) sends a story for Serviceman, which was prompted by cent comment on intermittents. Among things it concerns the failure of a set the absence of a HT by-pass.

A.: Many thanks for your story, R.B we will pass it on to The Serviceman. wouldn't like to speak for The Serviceman the matter of the time taken to recognise similar fault, but we suggest that you will it a lot quicker yourself next time. probably now realise, any set suffering both hum and instability immediately suspect and should be checked for a HT by-pass.

T.J. (Inala) writes to thank us for information previously supplied and to express appreciation of the magazine. He suggests we should describe a television receiver valves at a time, spread over several

A.: Glad to learn that the informati received OK, T.J., and that you find the zine so interesting. The exact position ing television for the home builder is not at the present time, and we must wait suitable components are available before can describe something suitable for readers. It is quite likely that it may be spread over more than one issue.

G.F.W. (Blair Athol, SA) sends a cont for the Serviceman concerning an unusual in a modern set.

A.: Many thanks, G.F.W., and we your letter on to The Serviceman. This is certainly an unusual one and the fa it was apparently missed by previous adds to the interest.

G.H. (Linton, Vic.) thanks us for hel him through the article "Here's What Want, Dad" then goes on to tell ab experiments with a crystal set and t amplifier.

A.: Thanks for your letter and we lighted to note that the article has th in your case. Your locality must actu quite a good one to record the resu mention from a crystal set, with or the transistor amplifier!

E.C. says he is a comparative newco radio, but has nevertheless learned a gre from reading RTV & H. The thing that stumped is how to identify the connect good but unmarked coils.

A.: This is a tough one, E.C., and is no easy way of discovering the rig wrong connections with a multimeter. have to draw on some experience and other observations as well. Rather than to answer here, we will pass your le to the writer who does the "Answer page. Maybe he will be able to assist

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Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

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Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

Dubbo, NSW) sends a subscription for 12 months of the magazine and says that this is his way of showing appreciation of the standard we have been maintain. He also describes the audio amplifier which he and a friend produced after much effort. Consisting of the 17 Watt Amplifier and the Crystal Control Unit, along with a few known items fore and aft, it is giving excellent reproduction, and thanks for the subscription. J.E.W., we have forwarded this to the appropriate department. You will doubtless have received official receipt before this appears. We are also glad to larn that you find the magazine interesting and we will do our best to keep it that way. The gear you have built should be capable of very good results without involving an extravagant outlay. All the best with it and the multiple speaker system. We decide to try it.

(Ernie, Tas.) says he read with interest reference in the July issue to a computer which can give the day for any date in the year 2000. He points out that the same information can be obtained from a universal calendar, of which a copy

Thanks for your letter, T.T. You are right, but it takes a good deal longer than a computer and on such a problem that hasn't even started. It isn't even a workout.

(Box Hill, Vic.) renews his subscription to R. T & H and encloses a couple of "howlers" clipped from his local paper. He also comments on people around Melbourne erecting large TV aerials, even though they have a direct line of sight from the transmitter.

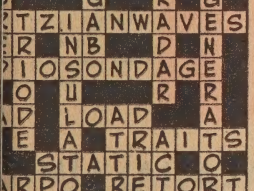
Thanks for your subscription and for the clippings. One of our staff is collecting some items for his own amusement. We agree with your remarks about the TV aerials, as is evidenced by the Editor's remarks in this issue page for August.

(East St. Kilda, Vic.) forwards a suggestion to cover circuits previously published and suggests that we describe the operation of a record changer in a future issue.

Thanks for the suggestion regarding the record changer, but we doubt whether this could be done. The number of types of record changers on the market is considerable and they all employ different systems, some of which are complex. If a particular type is popular we suggest you contact the manufacturer direct and obtain service data for that particular model.

(Hamilton, Vic.) wants to know why a certain type of speaker replaced the electrodynamic type, and when. Also how they compare as regards performance.

The Alnipermag speakers have a number of advantages over the electro-dynamic types and their performance was only delayed by the difficulty in obtaining sufficient flux density with a reasonably small magnet. This problem was solved during the war by the development of powerful permanent magnets and virtually all speakers made since the war have been based on this principle. Some of the advantages of the arrangement are as follows. No current is needed in the speaker field, hence no possibility of metal frame and less risk of hum fouling in the annular gap. In addition, tolerances are often possible. A smaller transformer (about 100 volts less primary) which costs less, generates less heat and occupies less chassis space. The lower voltage means less strain on the electrolytic capacitors and, in some cases, makes possible the use of lower voltage rectifiers with consequent saving of space and cost. No hum generated in the speaker coil is picked up in the field coil. It is difficult to compare the performance of the two types of speakers unless specific types are quoted, but it is safe to say that ordinary types have lost nothing by the change and better types have gained considerably. All in all the change has been for the better with very few disadvantages.



t month's solution

TV TUBE FOR COLOR

(Continued from page 9)

journey along the other side of the machine back to the starting point, during which it is cooled down at a predetermined rate to remove glass stresses &c.

The entire process takes from 20 to 30 minutes to complete.

Contrary to usual tube-making practice, the getter is not fired during the exhaust cycle, but in a separate operation after the tube has cooled down. It is claimed that this allows more accurate control of the getting material within the tube, and a more complete treatment of any gases which are still free inside it.

The last process is the attachment of the base and the soldering of the leads to its pins.

The tube now goes to an elaborate testing bay where voltages are applied to the elements and the screen illuminated and inspected.

Important tests are a complete inspection of the face under a microscope to ensure correct illumination of the colored dots, and the all important "white" test.

This involves the setting of the controls for each gun until the balanced blend of the three colors produces a completely white screen.

Just outside the test bay is a comparison tube adjusted for an acceptable standard of whiteness, so that the testing operator can refresh his eyes from time to time in case they develop an undesirable tolerance for any one of the three colors.

It is a particularly fascinating experience to see the screen illuminated first with one color, then with two, and finally with the third, when, instead of a mixture which the eye naturally expects, the screen appears as though suddenly wiped of everything except a white "color".

Only by close examination under the microscope is the eye able to see that the white is actually made up of myriads of colored dots.

These dots, incidentally are only visible if the microscope is correctly focused. If the focus is deliberately upset, the dots immediately combine once more and the screen appears white.

The ability of the three guns to be adjusted for this correct white mixture is a vital requirement of each tube, for without it proper color balance would be impossible, and the tube would not be able to receive black-and-white pictures of a quality indistinguishable from a standard black-and-white tube.

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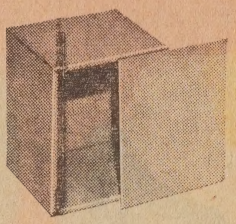

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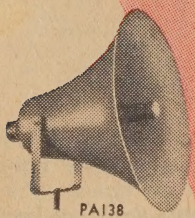

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Standard reflex horn speaker for medium distance projection of speech and incidental music.

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Standard exponential horn speaker for public address where distance projection of speech and incidental music is required.

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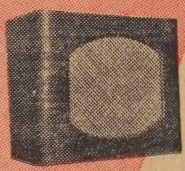

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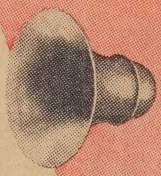

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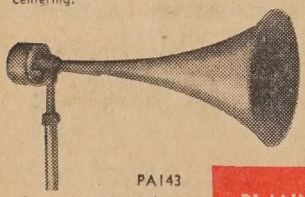

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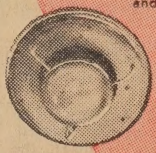

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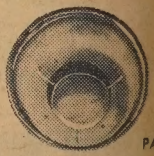

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H QUALITY CRO TIMEBASE

(Continued from Page 115)

suitable twin triodes, the the most readily available. At time other valves such as the 6SN7-GTA and 12AT7 would do a good job. The 12AX7 is u-low-gm type and may not quite as well. Another possibil- use a pair of cheap pentodes AC7's connected as triodes. We tried other than the circuit but there appears to be no by the alternatives should not story.

as the operation of the time- is concerned the layout is not ly critical. Excessive stray es would alter the high fre- overage but it is quite easy ge the switch and frequency ng capacitors close to the

CAPACITORS

ysical size of the capacitors ess than for the same low fre- overage with a gas triode and ete timebase can be constructed small space if required.

A point to watch when installing the timebase in a complete instrument is that stray coupling with vertical amplifier circuits be low. The high amplitude peaked waveforms which it generates require only a very small stray capacitance into high impedance low level circuits in order to cause considerable distortion.

Suitable ratings for wiring components should be fairly obvious. The resistors in the grid circuit of the 6BX6 and the 2nd 12AU7 section may be ½ watt types, similarly the two .1 meg resistors associated with the feedback circuit. All other resistors should be 1 watt types.

The power dissipated in the plate and screen resistances for the 6BX6 and the output load resistances is too great for 1 watt resistors under continuous load. Resistors capable of dissipating 2 watts are not always available and therefore we have made up the required values by series connecting 1 watt units.

The frequency determining capacitors could well be rated at 600 volts. At the same time 400 volt types would not actually be overloaded. Mica capacitors may be used for the screen suppressor coupling in which case the voltage is not in question. Output coupling capacitors would probably not break down if 400 volt types were used but we would prefer to see 600 volt units installed.

There are a number of aspects of the circuit which are capable of variation or perhaps further development. Provided optimum performance at the higher frequencies is not required it may be possible to choose a single compromise value for the screen/suppressor coupling capacitor. The cathode follower could be omitted in a cheap instrument.

A most attractive possibility is the provision of switching circuits to allow the 6BX6 to operate as an amplifier. The OA85 could be shorted by the unused position of a two-pole 5-position switch while another switch bank could take care of the grid circuit and cathode bias. It is quite possible that we will include such a circuit in a complete instrument to be described later.

REFERENCES

Little information in the form of complete circuits suitable for duplication is available. However, the books listed below contain theoretical discussions of the Miller timebase.

Briggs B. H. "Electronic Engineering" (periodical) August, September, & October 1948.

Chance B. & others "Waveforms" MIT Radiation Lab. Series Vol. 19.

Puckle O.S. "Time Bases" 2nd. Edition.

Kerkhof F. & Werner W. "Television."

Terman F. E. "Radio Engineer's Handbook" (transitron action).

Terman F.E. "Electronic and Radio Engineering", 4th Edition.

Terman F. E. & Pettit J.M. "Electronic Measurements", 2nd Edition.

The last two cover the subject from a similar point of view.

JILD YOURSELF A TELEPHONE

Continued from page 113

not stand much of this with- ing. A proper headphone cord better proposition, being made a flexible or "tinsel" wire. cords are already wired for eration and is only necessary t one pair of terminals to the and the other pair to the r to obtain correct oper-

air of leads for the receiver e passed into the angled hole ck (top in the diagram) of the to the main longditudinal hole, the opposite end. In spite of iver mounting bolt there is room for the two seperate on each side of it. The loops d of the leads are simply con- the terminals on the receiver.

TOO LONG

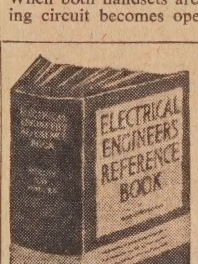
ads for the transmitter will need ortened to make a neat job, ing some soldering to the tinsel is calls for a little care, since is quite fine and easily dam- vage one of the terminal lugs r or clamp it to one of the wires. The other wire is left the moment.

ne two wires into the end of lle and bring them out the ole in the front (bottom). The the loop is now secured by the r mounting bolt (the trans- ill obviously have to come off achieve this) and the other is directly to the metal plate.

soldering the tinsel wire re- much cotton as possible first, a small amount of paste flux e the joint as quickly as pos-

only remains to connect the d of the handset cable to the fe terminals in the main unit set is complete. With both units d to opposite ends of the line the system should be ready for operation. The only point which should need checking being the battery polarity as already discussed.

When initiating a call, the handset at the calling station may be either lifted or at rest. If at rest the buzzer at both ends will operate; if lifted echo of the distant buzzer will be heard in the receiver, indicating that it is working. When both handsets are lifted the speaking circuit becomes operative.



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SELL: University OK.1 Oscillator Kits. Covers all fundamental frequencies in average receiver. Complete instructions. £12/18/9. Post free. Literature on request. **Thyron Radio Supplies, 233 Victoria Rd., Gladesville. WX3428.**

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SELL: Battery sig. tracer and oscillator, battery valves and parts cheap, not wanted Town now electric. Also Astrology books, twin lens camera gramo records. **W. Bennett, Bonalbo, N.S.W.**

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FOR SALE: Locomotive Blue Prints, Electric Diesel, Steam, O gauge. **Bolton, 72 King St., Sydney. Catalog 5/-.**

FOR SALE: Back Nos. R & H. Also American Radio News and English Worlds, 2/6 posted. **A. J. Cox, 13 Glover St., Belmont, N.S.W.**

SALE: All back issues R & H, Jan. 1943 to Sept. 1950, 2/- per copy posted, 15/- per year delivered in Sydney or 20/ per year posted. All other copies 4/- each or quote for quantity. **T. Weir, 73 Gibson Av., Padstow. UY8056.**

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WANTED: "Australian Official Radio Service Manual", vol. 9. **C. Ryan, 249 Campbell St., Rockhampton, Qld.**

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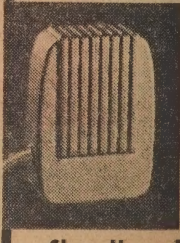

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